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National Electric Light Association.

Detailed Report of the Proceedings in Baltimore Last Week.

The Largest and Most Successful Electrical Convention ever Held in the United States.

A Number of Exceedingly Valuable and Interesting Papers Read and Discussed.

The Next Meeting to be Held at Detroit, Michigan, in August.

The first annual meeting of the National Electric Light Association convened in the Carrollton Hotel, Baltimore, Wednesday of last week, a summary of the first day's proceedings appearing in our last issue. The attendance numbered nearly two hundred during the session, and the interest displayed was very great. The splendid arrangements made by President Morrison, who resides in Baltimore, and his courteous staff, Messrs. Tuxworth, Garrett, McCourbray and others, were most complete in every particular, and we do not think that a single attendant left Baltimore with other than the most agreeable impression of the hospitality of that city and its prominent electrical representatives. When the convention assembled at noon, Wednesday, President Morrison opened in the following brief address:

"*Gentlemen of the National Electric Light Association*—The success which has attended our association so far must be very gratifying. Its numbers, its popularity and its usefulness must also afford you a great deal of gratification. From a small group of men who gathered together at the Pacific Hotel, Chicago, one year ago, it has grown to an association numbering hundreds of members, and its influence has already been felt through all the ramifications of the electric lighting business. We meet as scientists and as practical men. The former indicates the course along which the practical man walk and achieve such results as past history promises the future. Baltimore extends the hand of welcome to you, and I may say just now that all electrical apparatus invented in this country has had its birth or, to some extent, its fruition in this city. The telegraph, the telephone the electric light, the electric locomotive have, to some extent, first been made accomplished facts here. At our last meeting at the Hotel Dam, in New York, a distribution of the subjects presented to the convention was made to various committees, whose reports and the accompanying papers you will be called upon to consider. We have with us Maryland's representatives and the mayor of the city. The subjects to be discussed will include electricity as an illuminator, arc vs. incandescent lights, the placing of wires under ground, operating expenses, and the relation of electric lighting to insurance. The names of Dr. Otto Moses, Prof. George Benjamin, Major Heap, of the United States Navy; E. R. Weeks, Kansas City; Ralph W. Pope, George Worthington and C. J. H. Woodberry, of New York, are a sufficient guarantee of the intelligent manner in which their subjects are likely to be handled. Among those who have accepted invitations are Professor Rowland, of the Johns Hopkins University, whose reputation in electric matters is not confined to his own country. Lieut. Louis Duncan, of the United States Navy, chairman of the committee on the life tests of incandescent lamps and dynamos, instituted by the Franklin Institute, of Philadelphia; Prof. Kimball and Dr. Perkins, of the Johns Hopkins University. I have no doubt that during the session they will offer many valuable suggestions. I have now the honor of introducing to you the Hon. James Hodges, mayor of the city of Baltimore, whose name has been for nearly half a century identified with everything that was beneficial to the city of Baltimore—one who not only encourages progress, but keeps along, step by step, by her side; one whose words of welcome come not merely from the lips, but which are the genuine expression of the heart, the great heart of the hospitable people of Baltimore."

With this introduction, Mr. Hodges rose and delivered an address, in which he said:

"As the mayor of Baltimore, I extend to the delegates of the National Electric Light Association a sincere and cordial welcome to this city. As it is one of geographical centrality, whose inhabitants are proverbially kind-hearted and hospitable, I deem it not egotistical to remark that the place of your meeting is well chosen. I am only repeating a platitude when I say that safety to life and property and good living and good cheer are among the distinguishing characteristics of this community, and I underwrite this bond to you.

"The people of Baltimore cannot but feel a lively interest in the questions to be discussed in this convention. It was here, in 1844, that Morse first brought into successful operation his telegraphic line, connecting the cities of Baltimore and Washington. No grander result can ever be achieved by human genius over space and time. I witnessed its first operation at this end of the line in a brick building which stood on a small part of the ground now occupied by the City Hall with a feeling of awe and wonderment from which I have never recovered. A few days afterwards I went to Washington with some friends on a visit, and was introduced to Prof. Morse in his office at the Capitol. He explained his ingenious invention to us with a display of enthusiasm which was as childlike as it was delightful. It was here, in 1848, that George B Simpson exhibited the first successful sub-marine telegraph, the one now in practical use by all telegraph companies.

"It was here, in 1878, that the first practical test was made between the original Bell telephone and the Edison carbon transmitter, which resulted in favor of Edison, and brought about the consolidation of the two interests. Baltimore was the second city on the American continent, in 1881, to apply on a large scale the system of electric lighting to its public thoroughfares; and the first, in 1885, to equip and put into successful operation the electric railroad, which connects the village of Hampden with this city. Hence, as I have before intimated, the place of your meeting is most appropriately chosen. You have assembled here to develop and promote a science of great utility to the world; and which, in my judgment, is only in the infancy of its application to the necessities and comforts of mankind. As a means of protecting life and property, the system of electric lighting is only second in efficiency to an honest and efficacious police. Men are deterred from committing crimes under the glare of electric lights, though seemingly alone, for fear that some one from a distance, screened from view, may be looking on. An electric light is a nocturnal joy to an honest man, but a scarecrow to a thief.

"I will not venture to be instructive to this intelligent body of scientists, at whose feet I might sit to study the principles and appliances of electricity, but I will ask your indulgence so far as to say what, doubtless, you already know, that recently the electric light has been utilized as a means to aid medical and surgical diagnosis, and to assist, by its internal application, to illuminate the various dark cavities of the human form, which surgeons and physicians have had no previous means of exploring. This has been accomplished by the invention and application of an ingenious little electric light supplied from a small portable battery. But I will not talk to you any longer about a matter which you understand much better than I do. I will simply renew my best wishes for the success of your convention, and for the best possible mixture of social and intellectual enjoyment for yourselves while sojourning in our city.

"I would be pleased to see you all at the City Hall before you take your departure from Baltimore."

The report of the committee on the "Proper Construction and Maintenance of Wires," was read by Mr. Weeks, of Kansas City.

PROPER CONSTRUCTION AND MAINTENANCE OF CIRCUITS.

As the subjects of underground conduit and incandescent lighting were assigned to other committees, the following notes will apply to aerial arc circuits only.

Under the head of construction may be considered line-wire, supports, lamps and station connections; under that of maintenance, lines, lamps and dynamos. Since the important subject of line-wire was given to another committee, its discussion is omitted.

To guard against "trouble," and to facilitate its removal, the line should, as far as possible, be in sight from the ground, and should be so placed as to be readily reached. By such construction, trouble and the cost of attendance are reduced to a minimum, and one is freed from the endless complications of housetop work, with its manifold objections—*i. e.*, rights to be begged, bought or stolen; continuous delays in removing "trouble;" costly repairs to roofs, chimneys and fire-walls, together with all the thrilling adventures of a Boston line man.

On some narrow and overcrowded streets it may be policy to erect iron standards, but the danger of fire and of ground shocks is so great with such supports that those of wood are much to be preferred.

To prevent the insulations being cut by tie-wires, and to guard against excessive slack from stretching, poles should not be more than one hundred feet apart. With the best material and good workmanship, and by paying more attention to the general appearance of the line, we may gain in efficiency and do much toward silencing the outcry against overhead wires.

Aside from the necessity to comply therewith the rules of the Board of Underwriters should be observed, because they are founded in reason and are *generally* conductive to the interests of all parties. There *must* be a positive "cut out" on every loop. But, instead of placing it upon the building containing the lamps to be cut off, it has been found better to provide for it a special pole or support as near as possible, of course, to the entrance to the building, but independent of it or of any structure which is likely to be destroyed by fire. By so doing, control of the circuit is retained in the event of the total destruction of the building containing the loop. There have been instances where such an arrangement would have saved the circuit and prevented loss from rebate. Where high tension currents are employed, porcelain should not be used for outside insulation. The best insulators for this service are of hard rubber and of glass. By means of well-blocks and brackets, rubber hooks and glass insulators may be used for all outside work where it is common to employ porcelain knobs.

In entering buildings additional insulation of hard rubber tubing should be used. To avoid damage from water have entrance holes bored upward from the outside, and let the wire run from a fixture placed below the exterior opening, so that all drip shall be away from the building. For like drainage purposes, glass insulators are to be set at an upward angle and rubber hooks pointed downward.

Lamps must be suspended by some perfect insulator; vulcanized rings being the best known to our experience. The best service is given by stationary lamps. This is especially true of outside lights. Those hung with raising and lowering tackle are more liable to wear, breakage and variable contracts than are rigid lamps, and in cold weather the tackle may become so clogged with ice as to render them inaccessible. For like reasons, when it is necessary to place the light toward the middle of the street, some device similar to the Brady mast-arm will prove most satisfactory.

Hoods should be sufficiently large, not only to protect the lamp from the weather, but to allow access to its works while it is in service. The conical form, since it offers least resistance to the wind, is preferable to other shapes.

Globes should be deep enough to cover the arc when the lamp is trimmed full; and the aperture at the top should be no wider than will just allow the rod and holder to pass freely.

The dynamo room should be a clean, dry, well ventilated apartment. In no other can electrical machinery be kept in a condition to do the best and most reliable work. Let every dynamo be set on some sort of frame by means of which the tension of the belt can be easily changed; and, in addition, let it be carefully insulated from this frame by blocks of paraffined wood or some other equally good insulation. Wires from the

machine to the switch-board are best run either by way of the ceiling or beneath the flooring. Under no circumstances should they be laid upon the floor, where they are not only in the way, but are sure to loose their insulation through dirt and wear.

All station wires should be cased in rubber tubing as high as a man's head, and cables and lines connected with the switch boards must have similar coverings to guard against short circuits, fire, and injury to employes. To protect both machines and lamps, and the property of patrons, every circuit ought to have lightning-arresters at the station, one on each wire.

The proper maintenance of lines requires that all other wires be excluded from electric light poles. The apparent economy of partnership poles is more than offset by the increased care required to maintain lines in good condition. Such a combined system will result in greater danger of crosses and grounds, fires will be more frequent, and the lives of men, unacquainted with the handling of electric light wires, will be jeopardized.

The insulation of circuits should be tested several times daily, and all lines patrolled frequently. In searching for grounds, and in repairing open circuits, much time may be saved by using a magneto. Having attached the two wires of the open circuit to the station bell-box, the line man, with a duplicate magneto, goes to the break. When the wires are ready for connection, he uses the magneto to signal the station that the current may be turned on in five minutes, or some other previously determined period. In this way a search for a telephone, or a walk to the station will be avoided, and rebates will be reduced.

Dirt must not be allowed to accumulate on any part of the lamp. Rods, bases, switches, contacts, bushings, and globes should be kept clean, and screws well set. Rods require frequent burnishings with crocus cloth. Let there be a system of rigid inspection at varying intervals, and full and exact reports from the inspector as to the work of each lampman.

If properly tended lamps, need very little adjusting. In nine cases out of ten adjusting simply means cleaning. But one man should attend to the adjustment of any set of lamps; and these, if properly cared for by the lampman, ought to run for a long period, with little other attention. As often as once in two years, at least, it is well for the lamps to be returned to the station to receive a thorough overhauling, and to be repainted that they may present as creditable an appearance as possible.

In the annual contract with the consumer, there should be a clause especially stating that any working with the lamp by other than electric light employes, will relieve the lighting company from all responsibility for failure of light. Employes should be provided with badges worn in plain sight.

Machines run in series do not give as good results as when run singly. The tension is increased to the danger point, while oscillation and all other kinds of trouble are more difficult to overcome.

The insulation of dynamos must be tested as often as is that of the outside circuit, and all circuit connections and binding foot screws must be kept tight.

Having given the machine the most favorable setting, it still needs intelligent attention to maintain it in an efficient condition. Except in an unusual emergency, the necessity for calling an expert, will generally mean that the machine has not had proper care. The insulating parts will probably be found greasy and gummy and coated with metallic dust, which destroys insulation and causes trouble of various kinds.

In conclusion, it may be said that if circuits are properly constructed and cared for, they should work satisfactorily. If they do not do so, if they are in constant needs of repairs, if lamps require frequent adjustments, if bushings are continually burning out, the *meaning* is careless attendance; and of all this carelessness, failure in cleanliness will be found the most common fault. Given a well constructed circuit, cleanliness is the ounce of prevention that will obviate 90 per cent. of the vexations of electric lighting.

In the discussion which followed, Mr. Cooper, of Brooklyn, referring to the recommendation in the report to place poles 100 feet apart, said that his company were placing their poles 200 to 230 feet apart. He thought that poles placed 100 feet apart would be too much like a picket fence.

Mr. Weeks, in reply, referred to the fact that the insulation is very easily cut at the tie-wire. In order to prevent that, as large a tie-wire and as large an insulator as possible were used, so as to have a large bearing for the line and above all have the supports as near together as possible. Of course in some cases it is absolutely necessary to have the poles far apart. In cases where it is not practicable to construct in any other way, he would have long spans, but he considered it advisable in most cases to shorten the span.

Mr. King, of Minneapolis, said that in his city they were running some 225 lights suspended over the center of the street at the intersections, by means of a sheave pulley and winding drum. This system had been in operation a year. "We have," the speaker continued, "a great many zephyrs in the air there at this season of the year, sometimes snow and the thermometer gets down into the basement. I want to say that we have never experienced any trouble there. Our lamps work very satisfactorily indeed. We consider it very much the cheaper and preferable way and are very much pleased with the system."

Mr Cooper—"In what way is it cheaper?"

Mr. King—"It is cheaper and more effective. The apparatus which we use is the invention of a Minneapolis man. It costs us something like six dollars."

Mr. Cooper—"The cheapness is in the construction?"

Mr. King—"So far as attendance is concerned we have had no expense from that whatever. We hang our lamps so that with our apparatus the lamps can be lowered within twelve feet of the sheet. We can bring them down to the sidewalk if we want to. A carriage can pass by the lamp without striking it. It also furnishes facilities for adjusting the lamp while the current is on. We have trimmers who take a 10-foot step-ladder and travel probably six miles, and clean 40 to 50 lamps in a day."

Mr. Cooper—"Then that is about half as much as they generally trim, isn't it?"

Mr. King—"Of course they can trim many more lamps in a store."

Mr. Cooper—"On a stationary pole they trim more than that. We have trimmed 75 to 90 lamps on stationary poles. Therefore ours is cheaper."

Mr. King—"I wish you would tell me where I can hire one of those fellows. We set two poles and we run a telegraph wire across from pole to pole, and we put a double sheave pulley on that wire. The upper sheave runs on this supporting wire and the cable which suspends the lamp runs through the lower one, and back to the winding wire."

Mr. Linnell said that in the east especially city authorities object to wires running across the streets on account of their interference with processions, etc.

Mr. Ridlon thought that the liability to accident was the greatest objection to stringing lamps diagonally across the street. He had known many cases where the moving of a lamp backward and forward had so worn the wire that it broke and allowed the lamp to fall.

Mr. King said that in the system he had described they had a double support. The upper wire, which carries the sheaves and pulley, is the first. In addition to that they have a ¼-inch wire rope so that if the upper wire should break there would be no danger. He would not hesitate to run a 500-pound weight on that galvanized wire and swing it there.

Mr. Cooper said that his company had two poles with tackle like that described by Mr. King, and it broke and resulted in injuries to persons which cost the company $1,500. He thought the Brady mast-arm a good thing.

Mr. Morrison—"With the construction carefully attended to, there ought to be no danger whatever from the plan suggested. The objection has been recognized everywhere that that plan is adopted, however, that you have a number of unsightly wires across the street."

Mr. Cooper—"I have had experience with both plans, and I found one satisfactory and the other not."

Mr. Weeks—"I have had experience with both. The cost of construction is less with the lamp on the top of the pole, or by the use of the Brady mast-arm set out of the street. The cost of maintenance has been shown to be less. So that, if we have a more economical construction and more economical maintenance with that system, it seems to me the other must fall to the ground. Occasionally it is necessary to move a house. If that is done you have got to take all your tackle down. I know a case where a man got a little out with the light companies and hauled a 75-foot derrick up and down the street, and kept them moving their wires up and down the street hither and thither."

Mr. Cooper referred to another objection, which was that in putting out the lamps, a great many times the carbons were slid by.

Mr. King—"We have not had that trouble and we do not have a man with a derrick, and a brass band parading our streets. Occasionally we have a house moved. Though, as rule, our people are well pleased when they get located and stay right in one spot. As to the first cost, the cost to us is that of drum and the sheave and the wire rope, and the piece of telegraph wire and one poll, and it is not expensive up in our country. It is very cheap."

Mr. Weeks mentioned the liability to variable contacts as another objection to the system. It is almost impossible to keep your leading wires to the circuit tight in your binding posts.

Mr. King—"We have not met with that trouble in our experience."

Mr. Weeks—"I think you have; I saw your light."

Mr. King—"What time of night?" (Laughter.)

Mr. Smith, of Jamestown, N. Y.,—"We could not go to the expense of the gentlemen here who speak of erecting masts. We put one cable across the street, and we suspend the cable from the tops of buildings. We fasten a single sheave block in the center of the cable taking the lamp wires from the building to the lamp. We put the wires to binding posts and turn them around so they cannot get out, and we have no trouble with variable contacts at all. There is no necessity of any winding drum at all. All we want is a hook. The man gets on a step-ladder, lowers his lamp, and the swing of the wires draws the lamp right on the side-walk, and he is out of the way of carriages and everything."

Mr. King—"We first began, as this gentleman suggests, with a rope and wound it as he suggests, and it occurred to us that anyone, if so disposed, might get up there and let our lamps down. Now we have a rachet, and when the crank is pulled out, it takes some other crank—we have got lots of them, of course—to unwind it. We consider it reasonably safe.

The secretary submitted his report.

The treasurer's report being called for, Mr. Cooper stated that the amount of cash on hand was $862.48, and that he had vouchers for all payments.

Dr. Moses read a paper on "Electricity as an Illuminant," which will appear later.

In reply to a question of Mr. Ralph W. Pope as to whether the Paccinotti machine was not originally intended as a motor, Dr. Moses said that Dr. Paccinotti, who was then an entirely unknown person, came to the Paris Exposition and exhibited three of his models. He had been investigating the subject of motors, and before he had finished his machine the idea flashed through his mind that he would make it a generator, and the machine shows that he had that intention.

The convention then adjourned till 4 P. M.

Wednesday Afternoon Session.

After the convention was called to order at 4 o'clock, the secretary called the roll.

The secretary read telegrams expressing the regret of the members at their inability to be present, and their wishes for the success of the convention, from George S. Bowen, of St. Louis; the Fort Wayne Jenney Electric Light Company, and E. A. Sperry, of Chicago.

A paper by Mr. John W. Beane, on the "History and Progress of Electric Lighting," was read by Mr. Ryan.

After a recess of ten minutes, a paper was read by Mr. T. C. Martin, of New York, on the "History and Progress of Electricity as Applied to Motors."

The following resolution, proposed by Mr. Duncan, was adopted:

Resolved, That the associate members are entitled to all the privileges of the floor, except the right to vote.

Mr. H. W. Pope proposed the following resolution:

Resolved, That a committee be appointed by the chair to tabulate rates for lights existing in the various companies represented in this convention, and that said committee report at the next session of the convention.

The word "public" was inserted in the resolution on the suggestion of Mr. Duncan, and it was then adopted.

The president appointed on the committee Mr. H. W. Pope, Mr. Duncan, of Pittsburgh, and Mr. J. F. Noonan, of Paterson, N. J.

Dr. Moses, referring to motors, said the method of distributing electricity from central points, such as the coal fields, can be accomplished by low-tension machines. If, for instance, you burn your coal in the mine and simply transmit it to the surface to be stored, you can, by a proper arrangement of a series of battery systems, get your currents of any potential you please. You then will be able to insulate your line wire very properly. You can receive that safely at some city central station, there undergo a transformation into currents of low potential and distribute it then at the householders' door. That would probably be the way in which we shall use electricity manufactured directly at the source of the fuel.

Mr. Upton read a paper on "Transmission of Power by Electricity," given below:

Mr. President and Gentlemen:—At the Electrical Convention held last August, in New York City, in a paper I had the honor to read at that time, in speaking of electric-lighting stations, the following remark was made: "There is one thing, it occurs to me, I think electric-light companies should take into consideration, and that is, letting of power." At the Edison Company's station, Lawrence, Mass., a large number of Sprague motors are used, which run all day. They use from half a horse-power to five horse-power each. These Sprague motors are all employed at a good profit, and it has always seemed to me that every electric-light company should use their power in the day-time to run small machinery. You have it in your stations, why not use it?

Since then, information on this subject has been sought in every way and from all available sources. Electric power, in many places, has for some time been sold from central stations, just as steam power has been sold, and with profit to both seller and buyer. In Boston, this has been done by the Daft Electric Power Company, using the Daft system, and considerations of the results here attained will suffice to show the commercial value of electric transmissions.

Dynamos are run by an Armington & Sims Company's engine at a central station, supplying electric power to about thirty motors in various parts of the city. It is sold at $150 per horse-power per year, the price at present being about the same as that for steam for small powers. It is a curious circumstance that more power is sold than the engine can supply—a paradoxical state of affairs explained by the fact that almost no set of machinery is kept running steadily, and the company supplying power gains by the stoppages. At this station they have in use two Daft dynamos of 25 horse-power each, that are run by being belted direct to

a 50 horse-power Armington & Sims engine. The steam is generated in a steel tubular boiler set with the Jarvis furnace, and coal screenings are used for fuel. This power is transmitted all over the city, and is used for running all kinds of machinery, including sewing machines, ventilator fans, printing presses, elevators, and other work. The demand for power far exceeds the supply, as the company has let all the capacity of their engine, and have application for 300 horse-power more. It is the intention of this company to start a large central station to be run exclusively to let power. The present plant has been in operation over eighteen months, and the only interruption has been three hours, when other parties cut their wires by mistake. In many cases, these motors have supplanted small steam engines, gas engines and hired power. Customers claim that the power is more regular than they have ever used before, even when coming from the adjoining buildings. There is in Boston one engine running twenty-nine elevators. If every elevator was used at the same time the engine would not have over one-half the required power.

From all the information gained, the actual loss in the process of conversion of power into electricity and transmitting power from the dynamo to the receiver amounts to about 40 to 50 per cent. The manufacturers of the dynamos claim only a loss of 30 to 40 per cent., but it is a safe calculation to allow a loss of one-half. This, as has been explained, is more than made up by the excess of power that can be actually sold and paid for. Electrical transmission has the unparalleled advantage of being superior to the obstacle presented by distance. Then, again, it operates its miracles in perfect silence and repose. No force appears in the wire such as appears in shafting, in pipes with compressed air or water, in endless chains or belts; and, in case of powerful currents, insulation is easy. The conductor can be bent or shifted in any way while transmitting many horse-power, provided, of course, its continuity be not interrupted. It can be carried around the sharpest corners, through the most private rooms, into places where no other transmitter of power could possibly be taken. There is nothing to burst or give way. In short, such a method of transmission is the acme of dynamical science. At the present time steam is the foundation of electrical power. Water power is unsteady and not reliable. Gas motors are of limited power With improved steam engines, belted direct to dynamos, and the Jarvis process of utilizing low cost waste fuels, the cost of making power has been reduced, within the past few years, fully one-half.

The most important use to which the principle of electric transmission of power is at present being put, is the running of street railways. It was only a little over five years ago that the first electric railway was built in Germany, and to-day there are many in that country, where their practical success has been demonstrated. In France and England they are fast becoming popular, but it seems that those in America are yet almost of an experimental nature; in this branch of electrical science, at least, America is far from foremost.

The advantages of electricity over steam for railway purposes are many and great. In the first place, the bulky locomotive is done away with, as the electro or motor can be placed either under the car or on trucks by itself; in either case great weight and room being saved. The machinery for converting the coal into the power, or, rather, extracting the power from the coal, is not portable, but stationary, and can be placed in the most convenient spot. For transmitting the power, in many cases no difficulty has been experienced in using one middle rail as the conductor. Sometimes it has been found that the dirt sticking to the rails and the wheels formed a sort of crust so insulating as to prevent adequate communication From all the information I can gain on this subject, it is my opinion that the most practical way will be to use wires on poles. I understand this system is used in the West by the VanDepoele Company. The poles can also be made available for stringing electric wires for both incandescent and arc lighting. The future of this system is filled with possibilities. It will eventually become the motive power of all the present horse railroads. In a few years elevated electrical railroads will be as plenty as steam railroads are now, and in time it will supersede the present system of running locomotives on all railroads—and why not? It is simply a question of cost of making power. It is acknowledged by every practical engineer that the present system of making steam in locomotive boilers is expensive as well as wasteful. The evaporation of pounds of water to each pound of coal consumed to make steam in locomotive boilers does not average over three and one-half pounds of water, using the best grades of bituminous coal, while with stationary boilers set to burn coal screenings for fuel, an evaporation of nine pounds of water to one pound of fuel is made, and the reduction in cost of fuel is from one-third to one-half. It is only a question of time when all the different electric lighting stations in this country will use their engines in the day-time to make power to be sold for manufacturing purposes, the same as they sell power in the form of electric lights now. They can also furnish power to run electrical railways, elevated or surface. The economy of this system over the cost of running horses, as used now, will be over 50 per cent.

As to speed, it is impossible to give the limit which can be reached on electric railways, because those so far constructed are on streets or in localities where very rapid transit is not possible or desirable. On the very first one built a rate of seven miles per hour was customary. On the Berlin railway, opened in 1881, the greatest speed reached was at the rate of eighteen miles per hour. More was possible, but the police authorities refused to permit more than nine miles per hour. Up to August, 1882, there had been no breakdown on this road. On the Siemens' railway, at the Paris Exhibition of September, 1881, a distance of over 1,600 feet was traversed in a minute, which is at the rate of nearly twenty miles an hour. There is every probability that electric locomotives can be run faster than any steam locomotive now in use. About ten miles an hour is the average speed that a car can be run on an electrical street railway, but I think it is possible to run at the rate of 100 miles an hour. In the near future, on elevated railways this will, no doubt, be accomplished. I believe the time will come when cars will be run by electricity between Boston and New York in about two hours' time, where it now requires six hours by steam railroads. We Yankees call ourselves practical people; we believe in the success of the use of electricity for elevated and surface street railways; believing this, we propose to put it into actual practical operation Petitions are now before the present Legislature of the State of Massachusetts for charters for over a dozen street railways, part surface and part elevated, all to be run by some system of electric motors. In Massachusetts a horse railroad can be started under the general law; but, as the law stands now, an electrical railway requires a special charter. A petition has been presented asking for an amendment to the general law, and allowing electrical railways to be started the same as horse railroads are started now. We believe that the cost of power, as compared with the present cost of using horses, will show an economy of over 50 per cent. In the town of Winthrop, Mass., near Boston, sufficient money has been subscribed for erecting an elevated railway on the Enos system, to be run by electricity. The station will be constructed so as to include the use of dynamos for electric lights, and the elevated railway will be utilized for stringing wires to run them. If the charter is granted, work on this railway will be started at once. The plans are all made for an electrical station three stories high, the upper stories to be used as a manufactory, and power supplied from the station below—a most profitable way of utilizing the power of electric light stations in the day-time.

The electric station of the future will be erected to utilize power in hundreds of ways not now thought of. Central stations should be made large enough to combine all the present methods of using electricity, with full allowances for future discoveries, for I believe electricity is in its infancy. By this strange and novel agency power will be used to do its share toward the support and advancement of the human race. We may yet know, in our time, what electricity is, for to-day we only know it is a power that shows itself by its manifestations.

A professor in a college asked a student one day what electricity was. The student hesitated and tried to think of the correct answer, but in vain; it was of no use; he could not recall it, but in self-defence said, "I did know, but have forgotten." The professor replied, "This is terrible; the only man who ever knew what electricity was has forgotten the answer."

Electric light and power stations will be erected in the future as large as our present cotton mills; the engines will be used in the day time to run lines of shafting to furnish power for manufacturing purposes over the station. Power motors will transmit electricity all over our cities to run small machinery. Both arc and incandescent lights will be used. Perhaps storage may yet be a success. Electricity will be used to drive machinery, to produce ventilation, for heating purposes; the exhaust steam will also be used for heating neighboring buildings in cold weather.

There is no need to expatiate upon the advantages to be gained from an economical method of transmitting power; the costly and persistent attempts of inventors and capitalists to get better methods are enough to prove their desirability.

Many systems have been tried and found wanting. In electricity, thanks to living inventors, we have a force into which power can be transferred as by the wave of the magician's wand—a force which flows to any distance with rapidity of lightning and the stillness of a ray of sunlight, and then at bidding resumes its original shape quicker than thought can follow it.

In reply to a question of Mr. Weeks, Mr. Upton stated that he thought it practicable to run an engine and dynamo all the time. But he thought he would have a spare engine. There are several stations in New England running both arc and incandescent. He continued: "I think there is more money in selling power at $150 per horse-power than any electric light company is making selling light. In the New York Stock Exchange there is a motor of three horse-power that is running 300 tickers, and they are obtaining for that about $400 a horse-power a year."

Mr. De Camp—"I cannot see the difference between the arc and incandescent unless we duplicate our plant. The light, whether it be one or the other, may be said to commence at four o'clock. Now, we would either have to get our customers to dispense with the use of the motors at four o'clock or *vice versa*, or else double our plant. We are running about 200 small motors, used almost entirely for running sewing-machines. We charge for those motors a dollar a month. We will not make a contract for a less amount than five dollars. If a party puts in four motors, we will run those motors for five dollars a month. If he goes on and adds to those, we will charge him one dollar a month for every additional motor he puts in. They are supposed to be about one twelfth of a horse-power. We run them on arc circuits with arc lights."

Mr. Upton—"I rode yesterday on four or five different elevators running a mile away from the station. The motor was in the upper story locked up. These were freight elevators, but they told me it was just as easy to run passenger elevators in the same way. They ran with perfect ease. You have not begun to develop your business. That is my idea. I was talking to some people who are using the Daft system in Boston, who are paying $150 per horse-power. I think any of them would pay $300 a horse-power rather than not use them. My only experience has been where low-tension dynamos were used. I should suppose high-tension could be used with resistance-boxes, or something of the sort."

Mr. H. W. Pope—"With the Diehl motor there is no resistance. The field magnet is adjusted They work very successfully. I worked it myself and got a great deal of satisfaction of it. I worked it on a high-tension wire."

Dr. Moses—"Electrical horse-power has not been used to any extent in the Edison district, although they originally forecasted it. It is, to a certain extent, a manufacturing district, particularly north of Fulton street. Still, they have not introduced it. The cause is this, I think: It is not economical to run machines that are more valuable for light-giving purposes during the day, and the quantity of power demanded in that district is not commensurate with the amount of light that would be required in the evening. Where you use low-tension currents, the outlay for conductors is so enormous that you will only locate them advantageously in districts where large quantities of light are used. That the two systems should be combined seems to be the more feasible plan. The dynamos there being used for light at night can be coupled up for power during the day. Use high-tension currents and a duplicate system of smaller conductors, using higher potentials during the day and sending your current into the working districts."

Mr. Kerr—"Along Fulton street, New York, are a large number of jewelers, who use from 10 to 25 horse-power, and that is large, for electro-motors; consequently, they use steam-engines. North of Fulton street there is another cause which has not been mentioned. I think it is in an alley off Beekman street that there is a power station, with a large engine and a line of shafting that runs up some two blocks there. It goes over to the *Herald* building and to Park row, and power is supplied by it in small quantities. It is pretty hard to get those people to change, and that is another reason why you cannot sell electro-motors there."

Dr. Moses—"I would like to impress as strongly as I possibly can the necessity of dovetailing districts into each other—a district that uses light and a district that uses power, and using entirely different conductors, because, if you dovetail power and light, the difficulty referred to arises that at four to six o'clock in the afternoon they both want to be supplied, and they conflict. But you want a light district during the night and a power district during the day."

Mr. Cooper—"But you never have that same thing. It is night at one district when it is night at the other."

Dr. Moses—"Unless there were an intermediate link of storage between those points."

Mr. Cooper—"Unless we arrive at something which has not yet been accomplished."

Mr. Morrison—"I don't think the case will be solved until the question of storage is settled."

The convention then adjourned until the following morning at ten o'clock.

Thursday's Proceedings.—Forenoon.

The convention assembled at 11 A. M., with an increased attendance, a number of delegates having arrived during the night. President Morrison presided.

On motion of J. F. Noonan, a committee on transportation was appointed by the chair to consist of two members from the South, two from the East, two from the West and one as chairman. Messrs. Noonan, of Paterson, N. J.; H. D. Stanley, Bridgeport, Conn.; James English, New Haven, Conn.; L. M. Fishback, St. Louis; J. H. Yarbrough, Nashville; Geo. Wadsworth, Cleveland, and S. A. Duncan, Pittsburgh, were appointed.

Mr. Frederick Fosdick, of Fitchburg, of the committee on "Best Equipment for Arc Lighting Stations, Steam Power, etc.," stated that the committee had not prepared a written report and that he would make merely an oral report in order to bring the matter before the convention for discussion The best

(*Continued on page* 5.)

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We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

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Mr. J. Viennot, 150 South Fourth Street, Philadelphia, is our accredited representative for Pennsylvania.

Frank M. Gilley. 54 Equitable Building, Boston, Mass., is our New England representative.

Mr. C. C. Haskins, 118 LaSalle Street, Chicago, Ill, will represent the REVIEW in the West.

Messrs. Wm. Dawson & Sons, 121 Cannon Street, London, England, are our representatives for Great Britain.

NEW YORK, FEBRUARY 20, 1886.

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The station of the Electric Light Company, of Brockton, Mass., using the Thomson-Houston system, was flooded by the rain of last week. The dynamos were submerged and some little delay will be caused by the damage before the station can be running again.

In the United States circuit court at New Orleans the telephone case of the Bell Company against the National Company, has been postponed until the 23d inst., after the conclusion of Mr. Storrow's argument for the Bell Company, to enable Judge Pardee to make his circuit.

Solicitor-General Goode is now engaged in the preparation of a bill to be filed against the American Bell Telephone Company to vacate and annul its patent. He says that the suit will be instituted as soon as the papers can be prepared and that no decision will be reached in regard to the place of bringing it until all the papers are ready.

Our readers will find a complete, connected report of the proceedings of the National Electric Light Association in our columns this week, every feature receiving mention. The number of valuable papers presented and the exhaustive discussions that followed compel us to give a summary of one or two of the leading topics which will be treated in full in our next issue. These two editions will be of great interest to the electric lighting people, presenting a verbatim report, taken by the REVIEW's stenographer.

It was a very proper thing for the National Electric Light Association to unanimously re-elect President J. F. Morrison. He is the right man.

A most disastrous sleet storm visited the New England States last Thursday night, and the telephone exchanges in Worcester, Lowell, Bangor, Me., Newburyport, Portsmouth and other cities are very badly damaged. The loss to the New England Telephone Company it is estimated will be over $10,000.

The Phonoplex, an apparatus for duplexing way-stations, is to be generally introduced, Mr. Paul Bossart, a well-known telegraph and telephone man, having resigned from the superintendency of the New England Telephone Company to take general charge of the business. Mr. Edison invented this valuable apparatus, and in Mr. Bossart secures the services of a gentleman well fitted for the intricate work of successfully introducing and operating it.

THE ELECTRIC LIGHT ASSOCIATION.

There was much that was interesting and valuable to be learned from the work of the National Electric Light Association during its three days' session in Baltimore last week. Delegates and visitors were made to feel at home in hospitable Baltimore, the arrangements at the Carrollton Hotel being very complete and convenient. There was no delay in getting to work. Several important papers were presented and discussed at the first session, in addition to the essential detail necessary at the opening of all conventions. There was a snap and vigor noticeable throughout the proceedings, so much so that it was generally commented on by the visitors, who were evidently unused to the quick methods that prevail where electric light men assemble. The presiding officer, Mr. J. F. Morrison, never appeared to better advantage than on this occasion, when in addition to his very onerous official duties, which he so satisfactorily performed, he felt that some social obligations as a Baltimorean were naturally his. In this respect he proved a prince of hosts, and was greatly aided by his associates in the electrical business in the "Monument" city.

Two sessions were held each day, from ten to two, and from four to seven o'clock, and the full report of the proceedings published in our columns is abundant proof of the splendid work accomplished. Four great topics were particularly prominent—Power, Underground Wires, Insurance of Electric Lighting Stations, and Incandescent Lighting, and much that was new and valuable was brought forth in connection with these. In the matter of carbons, of globes, of service, of electric motors, of circuit construction, and the historical matter presented to the convention—one and all were entertaining, practical and well received. Interest in the proceedings did not lag a moment. In no three days has there ever been so much accomplished to practically inform and benefit the electric lighting interests, and this is largely due to the admirable work of the presiding officer and of the Executive Committee, in their excellent arrangement of a comprehensive programme. During the six months intervening since the last convention, the Association had been increased by the addition of many strong and active members, and their presence was felt and recognized in the Baltimore meeting.

The re-election of the officers was a wise decision on the part of the Association. The work they have done in the past is more than sufficient guarantee for the future. The Executive Committee was strengthened by the addition of several new members, gentlemen who are earnest workers in the electric lighting field, and whose advent cannot fail to be of great benefit to the Association. There is little more to say. The proceedings, which we present in the REVIEW, speak. The Association is now one year old, and we do not hesitate to say that no other practical, scientific organization ever became so influential and powerful in so short a time, or showed such thorough equipment for future progress as the National Electric Light Association.

ELECTRIC LIGHT CONVENTION NOTES AND NAMES OF EXHIBITORS.

There were a number of fine exhibits that attracted the attention of delegates and visitors to the hotel in Baltimore. They were the Southern Electric Company, of Baltimore, represented by T. Howard Tuxworth; Morrison Electrical Works, Baltimore, by T. McCoubray; American Electrical Works, Providence, by Eugene Phillips and Geo. L. Beetle; Day's Kerite, New York, by Clark B. Hotchkiss; Okonite Company, New York, W. L. Candee; New England Butt Company, Providence (braiding machinery), by H. N. Fenner; New York Insulated Wire Company, W. B. Dowse, Jr.; Calender Insulated Wire Company, New York, W. O. Callender and C. M. Thompson; New England Glass Works, Boston, E. D. Libbey; Bishop Gutta Percha Works, New York, H. A. Reed; Brown Electric Company, Pittsburgh, Harold P. Brown and Geo. F. Carter.

The Western Electric Company was represented by Frank W. Harrington; Bridgeport Brass Company, by H. D. Stanley; Holmes, Booth and Haydens, by J. L. Barclay; Ansonia Brass Company, F. G. Stone; Schieren & Co. (belting), by F. A. M. Burrell, of New York; Schultz Belting Company, St. Louis, by Mr. Schultz; Dorsett Conduit Company, by D. H. Dorsett; Alfred F. Moore, of Philadelphia, by Chas. C. King.

The engine and furnace manufacturers were represented as follows: Armington & Sims, Providence, by Gardiner C. Sims; Westinghouse, Church, Kerr & Co., New York, by Walter C. Kerr; Fitchburg Engine Company, F. Fosdick; Jarvis Engineering Company, Boston, A. F. Upton; Ide Engine, by M. E. Hershey, of the Foundry and Machine Department of the Harrisburg Car Manufacturing Company.

The Brown Automatic Converter, of Pittsburgh, attracted particular attention in the parlors of the Southern Electric Company, where it was exhibited. It was set up so as to show the arc and incandescent lamps on the same circuit.

Mrs. Chas. Cooper wife of the treasurer of the Association, was presented with a very beautiful basket of flowers, by several gentlemen of the Association, who desired to testify their appreciation of her presence in the meetings. The donors were Messrs. Linnell, Stone, Kerr, Harrington, Cleveland, Price, Fosdick, Pope, Russell and Ridlon.

A number of the exhibits were placed in the parlors of the Southern Electric Company, the whole making a very noticeable and elaborate display.

The fine display of braiding machinery by the New England Butt Company, which was set up in the lobby of the hotel, was one of the most interesting exhibits, and was continually surrounded by an animated crowd of inquirers.

A commercial tourist, who complained that his fate had landed him in a hotel with a convention about a dozen times this year, freely admitted that the electric light delegates comprised the most substantial-appearing and wide-awake body of men he had yet met.

The leading carbon manufacturers were well represented. Messrs. Fishback and Russell appeared for the Parker-Russell Company, of St Louis; Messrs. Dickey and Porter, for the Pittsburgh Carbon Company; Geo. H. Wadsworth, for the Boulton Carbon Company, of Cleveland; J. L. Barclay, of the Forest City Carbon Company, of Cleveland.

A number of valuable papers, with the discussion that followed, are crowded out of this issue, and will appear in our next edition.

The Baltimore electric railway was visited by numerous delegations, who enjoyed a ride on its three rails, and were favorably impressed with the results they witnessed.

Johns Hopkins Institute was visited, Prof. Rowland doing the honors. The sight of a dynamo, with a complete Siemens armature, wound by Prof. Rowland in 1868, greatly impressed the electric-light men as they reflected on the fortune that the professor had at one time within his grasp, but which was not realized by his friends, to whom he submitted his invention some eighteen years ago.

LIST OF ATTENDANTS.

The names of the delegates and visitors to he convention are given below:

J. F. Morrison, Baltimore; Arthur S. Hickley, New London, Conn.; Frederick Fosdick-Fitchburg, Mass.; J. F. Noonan, Paterson, N. J.; George F. Porter, Pittsburgh; D. L. Mitchell, Taunton; S. A. Duncan Pittsburgh; F. A. M. Burrell, New York; A. J. DeCamp, Philadelphia; H. M. Linnell, Hartford; Clark B. Hotchkiss, New York; Frank Ridlon, Boston; E. R. Weeks, Kansas City; George F. Carter, Pittsburgh; H. McL Harding, Boston; Ralph W. Pope, New York; W. H. Fitzgerald, Detroit; T. M. King, Minneapolis; Geo. H. Wadsworth, Cleveland; Frank G. Stone, New York; D. Howard Tuxworth, Baltimore; A. L. Ide, Springfield, Ill.; L. M. Fishback, D. R. Russell, St. Louis; Wm. F. Swift, Cleveland; F. W. Harrington, New York; D. H. Dorsett, Chicago; H. M. Cleveland, Hartford; H. D. Stanley, Bridgeport; George Worthington, Andrew J. Dam. Chas. W. Price, R. W. Ryan, New York; C. J. H. Woodbury, Boston; George L. Beetle, New York; James English, F. A. Gilbert, New Haven; Joseph A. Corby, St. Joseph, Mo.; Eugene T. Lynch, Jr., New York; Edward A. Maher, Albany, N. Y.; Walter C. Kerr, New York; A. L. Upton, Boston; D. L. Evans, Baltimore; Allen V. Garrett, Boston; Eugene Phillips, Providence; Henry W. Pope, Elizabeth, N. J.; Zack Latshaw, McKeesport, Pa.; Charles McIntire, Newark, N. J.; E. D. Libbey, Boston; W. B. Dowse, Boston; Gardiner C. Sims, Providence; Brainard Rorison, Indianapolis; H. N. Fenner, Providence; D. D. Dickey, Pittsburgh; F. E. Cabot, Boston; John E. Sweet, Syracuse, N. Y.; C. E. Stump, T. C. Martin, New York; Willard L. Candee, New York; Charles Cooper, Brooklyn; H. K. McCay, T. W. King, Mr. Stuart, Baltimore; W. O. Callender, C. M. Thompson, A. C. Shaw-New York; N. J. Jordan, Auburn, Me.; F. W. Rollins, Boston, Mr. Schultz, St. Louis; T. McCoubray, Baltimore; Charles C. King, Philadelphia; Henry A. Reed, New York; John McCahey, Providence; H. P. Frost, New Haven; W. P. Bryan, Washington, J. L. Barclay, New York; Col. H. M. French, Boston; H. W. Spang, Reading; Dr. Otto Moses, New York; Reuben T. Robinson, Providence; M. D. Law, Philadelphia; Edwin D. Mullen, Philadelphia; A. M. Renshaw, Washington, D. C.; Lieutenant Duncan, U. S. A.; Professor Rowland, of Johns Hopkins University; Major Byrne, Cincinnati; Fred Royce, Geo. T. Maynard, Washington, D. C.; A. H. Bauer, Baltimore Richard Garrett, Baltimore.

THE WIRE GAUGE.

Editors Electrical Review:

In spite of the careful precautions, I find that two errors crept into my printed table of the Standard Wire Gauge, and were copied into your publication of the same, in issue of Feb 6th, 1886.

The weight of a mile of No. 6 iron wire is 512.07 lbs., instead of 572.07 lbs., and the weight of a mile of No. 9 iron wire is 288.04 lbs., instead of as printed.

Yours respectfully,
C. H. BARNEY,
Secretary.

New York City, Feb. 12, 1886.

National Electric Light Association.

(*Continued from page* 3.)

steam power was in reality the question that was before the convention. Electricity is dependent upon steam power. Although there are occasionally arc stations run by water power, they are so few as to need no attention at our hands. The question of the best equipment is divided between the best engine and the best boiler. Mr. Fosdick here alluded to some early experiences with engines and dynamos, stating that high-speed engines were chiefly used in the initial steps of electric lighting, at that time close regulation being an essential. High speed and dynamos went together, and it has been pretty hard, until the present time, to dissociate those two facts. Of course, the electric light competes with gas. Just as soon as the question of the success of the electric light was settled, the question of economy came in. The question has come prominently to the front whether high-speed engines are the best, all things considered, economically and otherwise, or lower-speed engines, and to what degree low speed is essential or advisable or to what degree high speed is essential or advisable.

"It is a fact that many of the largest stations in our country to-day are filled up with low-speed engines, higher, perhaps, than the old slow-speed, but still, compared with the high-speed engines, low-speed engines, and these stations are giving marked economy, and where there has been a comparison between these high and low-speed, direct, practically, I think the decision has been that the light has been equal to that of others and the economy has been much greater. It is also true that the larger the engine, the closer the economy regardless of high or low speed. The question comes in, then, as to whether not alone in large stations using large engines, low speed is economy, but whether taking a given power, say 100 or 50 or 150 horse-power, without regard to the power of the engine, a low-speed engine of a given power is more economical than a high-speed engine of a given power. There are certain elements entering into high speed which are inseparable from it, which are elements of lack of economy. There are also elements of economy. The elements of lack of economy in a high-speed are increased friction and increased clearance in proportion to the power of the engine. The elements in the low-speed engine are the necessity of a line-shaft to belt from, because it is almost impossible to belt from the pulley to the fly-wheel. The element of the large shafting is the principal element of loss in the low-speed engine. The question then is whether the belting direct and the loss by clearance and these other items more than offset the question of the extra friction required by the line-shaft and the extra first expense on the lower speed. These questions, I think, the majority of the committee who have this matter in charge will decide in favor of the low-speed engine, and I think I may say that for the majority of the committee, although I represent merely my own views. There are certain places where high-speed engines must come in of necessity. Lack of room in many cases prevents the application of the longer stroke and of the line shafting which is essential with the low-speed engine. So that in certain cases regardless of economy there must be the high-speed engine. With regard to boiler, the opinion of the committee, perhaps, would be that all in all the horizontal tubular steel boiler is the boiler for use in electrical light stations. In my view the proportion should be, for 100 horse-power, 1 in 30 for grate-surface to heating-surface; such a proportion of tube-area to grate-surface as 1 to 7½ or 8; a proportion of tube-length to tube-diameter of from 45 to 60. The diameter of tube would depend somewhat on the fuel used, larger for lighter fuels, smaller for more solid fuels—the harder coals. I think the space from the grate to the belly of the boiler should be not greater than 32 inches nor less than 24 inches. As to draught my observation is that a large chimney and a very large draught-check is necessary. The setting of a boiler has much to do with its efficiency. I believe that a careful setting of be the boiler to the very best plan that can be furnished, and even if at some additional expense is a great saving over the usual setting of boilers."

Mr. A. F. Upton, Boston, Mass.—"At least half the arc light stations, and at least three-fourths of the incandescent light stations in the United States use high-speed engines. We have between 40 and 50 stations now, and I am happy to say that all our stations are on a dividend, earning and paying basis. I think that fact settles a good many difficult points."

Mr. DeCamp, of Philadelphia—"I would like to have the question of clutches discussed here. I think everybody is interested in it. I think as the business grows we will all be running under similar conditions. We have one plant or rather two plants in one. We have got 250 or 260 day-lights. Of course we would rather have it at some other time. We have only four hours of economical load on our engines and I do not see any way of getting around it. If we could have an engine of half the size to run on this day load and use our large engine, say from 4 to 12 o'clock at night, and then cut off on to a smaller engine, working up to its economical point, we would be getting at the highest economy in the motive power. As yet we have learned of no clutch which we have any reason to believe can be depended on."

Mr. Evans, of Baltimore—"When we first started we tried a small engine; that we replaced with a larger one I have demonstrated by experiment both here and in Norfolk, Va., that there is more economy in running a long-stroke engine. The Armington Sims and several other engines which have been tested at Norfolk have been giving good results. But I think if the Norfolk people had to rebuild their stations they would certainly put a long-stroke engine in. Their consumption of fuel down there ranges from 56 to 62 pounds per lamp; whereas here in Baltimore we use an average of about 36 for the same number of hours run. Our experience with clutches was so unsatisfactory that we took them all out. They were a complete failure. We have adopted the fast and loose pulleys and they have given us the best results. I do not know of any clutch in the market that is capable of doing the electric-light work, though I admit a suitable clutch is probably the thing we want. We are using the Jarvis furnace, and it is giving us everything we expected from it. The retort furnace was a complete failure with us."

Mr. McGrath, of the New York Brush Company—"We have now in our stations in New York about 1,600 horse-power. It is nearly all made up of what we term slow-speed engines. Each of those engines is coupled up with what we term an internal gearing, so that we get the advantages of a high-speed engine without the disadvantages. We found it was economical not to use any clutch-pulleys, loose pulleys or anything else. Each dynamo was belted direct to its own line of shafting, and we calculate to keep on each engine one spare machine. We have also two small Ball high-speed engines that make a great number of revolutions a minute. The piston speed of those engines is not so great as the piston speed of our large engines, but they turn around more times in a minute. We are satisfied, from our experience, to use the low-speed engines. We use the plain tubular boilers. Our boilers are 16 feet long by 5½ feet in diameter. We have 15 of those in use. We use the Jarvis furnace. Most of our machinery has been running now for a little over four years, and we have never been obliged to stop one of our engines for any purpose whatsoever from the time we start till the time we shut down. We have never had occasion to reset one of our boilers. An electric-light station, properly equipped, will be so arranged by switching arrangements that we can stop any engine, any machine, in any part of the station, and change it on to another machine in another part of the station without any loss of time. We find no difficulty in doing that at all. We use Buckeye bituminous coal. We burn this time of year twenty tons a day. We figure our consumption of coal and everything in dollar's worth. As to the amount of coal we burn per lamp, it costs us $2\frac{9}{10}$ of a cent for each lamp for 10 hours—that is, a 2,000 candle-power lamp. My experience with fast and loose pulleys on dynamos has been that it takes as much power to run them as the dynamo."

Mr. J. F. Morrison, Baltimore—"The New York station, when first equipped, had the same sort of switching arrangement as the old Twenty-fifth street station in that city had. I have not seen it since then, and I did not know but the gentlemen in New York had invented a plan by which they can handle this thing better than is done in other parts of the country. But I find that from the coupling up of their machines that if a machine is disabled he has got to keep on running all night long. Now, a condition may arise whereby a machine, being disabled, will so cross-connect itself that, unless you stop the machine, it is going to set things in a blaze; so that there is a clear case where the entire plant on that engine would have to stop, in order to get rid of that machine To return to the switch-board arrangement again, it is quite common for the Baltimore men to make the changes suggested by Mr. McGrath. We have just a barely perceptible darkening of the lights. Our switch-board is arranged with swinging jaws, and into the jaw is introduced a plug switch with a wooden handle. The handle is hollow and the wires are carried up through the handle to the solid part of the plug. The switching is done by operating quickly, and introducing the plugs again. As to estimating the cost of fuel in dollars, that is the method which seems to be adopted by the gentlemen with whom we have been in correspondence, who do not want to tell anything. In our station we use a mixture of slack, soft coal and anthracite, mixed with three tons of screenings to one ton of soft coal. Of that mixture we use four pounds and a fraction per lamp per hour, varying to some extent upon certain varying conditions with which you are all familiar. The price of our coal varies. In January, 1885, we paid $1.90 a ton for the mixture; in January, 1886, they stood at $2.10 a ton. Owing to this heavy storm, we were unable to get the screenings into the station, so that gives you the reason for the increase of price there. We ran out of screenings two nights last week, and we then ran our engines on bituminous coal entirely. The cost of that coal was about $3 a ton and a little over. We found that, instead of 4 pounds and a fraction, we were using 3½ pounds per lamp The difference in the cost was very much in favor of the mixture. We use the Jarvis furnace, which I consider that all well regulated electric-light stations ought to use who are trying to bring about an economy of fuel. We use a Ball engine connected to one of the 26 Brush machines, 65 lights, and in that case we have an illustration of the direct belting with extreme high speed. In the other cases we use the Buckeye engine, 15×30 and 16×32. If we were to increase our plant now, we would put in a 600 horse-power engine instead of six 100 horse-power engines. As to carbons, we use more largely of the Brush carbons than any others, but we will use more largely of the others unless the Brush Company reduces the price very materially. It is important to have a skillful, efficient and zealous superintendent. If you have a slouchy, easy-going superintendent, you will spend more money in that department, without getting proper returns, than in another department."

Mr. Smith, Jamestown, N. Y.—"The only engine that finds favor in England now is the compound condensing engine My engine at Jamestown is a compound condensing engine. We run at 72 revolutions a minute. As a proof that we get the steadiest light possible, we are running the incandescent light on the same circuit with the arc light, and there is not the slightest perceptible flicker. You cannot get economy with a single-cylinder engine. You cannot get economy with a high-pressure engine."

Mr. Cooper, of Brooklyn—"One objection to using condensing engines in our cities is the cost of water. It would cost us more for the water than for the fuel."

Mr. Smith—"I recognize that in many cases it cannot be used. But where you can get water for nothing it will be economy to use it. The maker of the engine I have will put in an engine and guarantee that it will not cost more than £1 a year for fuel, and your coal bill shall not exceed £300 a year for 300 horse power."

Mr. Kerr, of New York—"We know that compounding produces a very great effect upon the differences in cylinder temperature, and that is one of the objects of compounding, even if we leave out the question of condensing for vacuum."

Mr. Upton—"We have an Armington-Sims engine 16½ × 24, which is doing a duty of $2\frac{88}{100}$ pounds of anthracite coal per horse power."

Mr. E. T. Lynch, New York—"We have just put in a 500 horse-power condensing engine, known as the Watts-Campbell-Corliss engine. We get our water from Twenty-ninth street at the East River. The consumption of fuel in that engine is $1\frac{7}{8}$ pounds of pea coal per horse-power per hour."

Mr. Weeks expressed himself in favor of the large engine. "As regards economy," he continued, "I think there is no question but that the balance is in favor of the large engine. We have demonstrated that matter in our plant We put in a 150 horse-power Corliss engine, and we found we got better results out of those large engines than we do out of smaller engines, which we have subsequently put in."

Mr. Kerr said that a large engine of any kind is more economical than a small engine of the same kind. A large single valve engine is more economical than a small four-valve engine, etc. Until you get to about 75 horse-power, it does not make any difference what kind of engine you use for economy.

Professor Sweet—"I would like to help the gentlemen out. If they have engines that are governed as closely as I see some engines governed, there would be no difficulty in using the ordinary clutch. If your engines do not govern close enough, why not put counters or indicators on the two engines, start up your engine, running on till it comes up to the speed of the other engine, then pull on the other clutch, the minute the introduced engine takes the load and the other is shut off, one will take the load. Pull out your clutch and let it go on. It seems to me there is no trouble at all if you come back to the original clutch."

Mr. Gardiner Sims—"In regard to the high-speed engine, we placed three in the Edison Central Station, in Pearl street, New York. They were 14½ in. diameter by 13-inch stroke, and two ran 350 revolutions. One of them ran 16 days for 17½ consecutive hours making 8,500,000 revolutions without stopping. These engines have been in use 3 years and 3 months, at eleven hours a day and they have made 272,000,000 revolutions. The expenses for the 3 engines for the 3 years and 3 months, have been $41."

Mr. Kerr—"We recently made a test on a 12x11 engine running, I think, 320 revolutions, which was put in under a guarantee of $3\frac{75}{100}$ pounds of coal and the test was made and showed an economy of $3\frac{44}{100}$."

The discussion, after some further remarks by Mr. Fosdick, Mr. Smith and others, was closed.

The secretary made an announcement of a visit to the Baltimore Electrical Rail way.

Mr. H. W. Pope—"I shall probably be called away this afternoon and there are some few matters here I have been requested to introduce. I move as an Amendment to Articl III. of the Constitution of this Association the following: Strike out all after the word 'Executive Committee,' and add 'shall be entitled to all the privileges of the Association, but shall not be eligible to office or entitled to vote, and such associate members may be appointed to serve upon committees in the judgment of the Executive Committee.'" Adopted.

Mr. H. W. Pope.—"The Telephone Asso-

ciation, of which I have been a member for a number of years, at their Convention in 1884, formed a very intelligent and competent committee to take up the subject of wire gauge. This committee, of which Mr. Sargent, of Brooklyn, was chairman, made a report, and this report recommended that the English standard gauge which was regulated in England by an Act of Parliament, to take effect by the 1st of March, 1884, be adopted by that Association. They have sent a communication to this Convention addressed to the president, which, with your permission, I will read:

J. F. MORRISON, Esq,
President Electric Light Association.

Dear Sir:—I have the honor to notify you of the adoption by this Association at its annual meeting of September last of the Standard Wire Gauge, which is now recognized as the official gauge by the English government. At the same meeting I, as secretary, was directed to correspond with other Electrical associations with the view of inducing them to take similar action, and thus in time do away with the confusion resulting from the multiplicity of gauges now in use. It is believed that should a common standard gauge be adopted by the Electrical fraternity, a concerted effort will induce Congress to legalize the same in the enforcement of contracts. There can be little difference of opinion as to the desirability of such a result, and the subject has been agitated in our Association for some time, and as a result, a committee on Standard Wire Guage was appointed at the Philadelphia meeting in 1884. This committee obtained a great amount of information, secured the opinions of many electricians and manufacturers, and embodied the same in a report made to our meeting in 1885, a result of their investigations recommending the adoption of what is known as the new English Standard gauge as the official gauge of the National Telephone Exchange Association. This recommendation was adopted. The report of the committee and the discussion thereon will be found in the report. I send you by this mail an advance copy of the same, and also several copies of the table of dimensions, resistances, etc. I trust you will bring this matter before the Associa ion.

"Now, Mr. President, I offer the following resolution:

Resolved, That the new English Board of Trade Standard Wire Gauge adopted by the National Telephone Exchange Association September 8th, 1885, be, and the same hereby is adopted as the official gauge of this Association;

Resolved, That the President take such steps as in his judgment may seem necessary through a conference with the Telephone Association, or other associations interested toward inducing Congress to legalize the same in the enforcement of the contracts;

Resolved, That 1,000 copies of said Standard gauge be printed for distribution by this Association.

The resolution was seconded by Mr. Cooper.

Mr. H. W. Pope—"It is hardly necessary to discuss this matter. It is a subject with which we are all pretty familiar. There are any quantity of gauges, and almost everybody knows the difficulty experienced not only in the electric light business, but in the telephone business, and it is very essential that this Association do what it can to adopt a uniform gauge, and therefore I hope that this resolution will prevail."

Mr. Ralph W. Pope—"I would like to inquire about the larger sizes of the gauge—whether it runs uniformly up so that the larger sized wires used by electric light companies will also be uniform, so that the same uncertainty will not prevail that does now."

Mr. H. W. Pope—"The largest size they have here is No. 4.0."

Mr. De Camp—"That I think a very important thing, because the confusion of sizes of wire is a very great annoyance."

Dr. Moses—"I would like to ask Mr. Pope whether there has been any very decided objection to the French system."

Mr. H. W. Pope—"I would say for the information of the gentlemen that in looking over the discussions before the telephone invention, there were a good many recommendations as to the diameter of the wire. They received replies from fifteen different parties, and those parties were made up of people who are very particularly interested—manufacturers for instance, and several of those replies favored the English and two the American gauge, and six had no preference. I have not been able to give this subject a great deal of attention, because it was only brought to my notice yesterday."

Mr. Cooper—"As an amendment to that resolution I would move that the chair appoint a committee of three with authority to act in the interests of the Electric Light Association and report such action at the next session. That is, they can adopt it if they think it is for the benefit of the Association."

Mr. Smith, of Jamestown, N. Y.—"The difficulty now is in the multiplicity of gauges. Now, you have got Brown & Sharpe's and Stubbs' gauges, and the American gauge and the new English gauge, and things are so mixed up a man cannot tell what he is doing."

The amendment was adopted.

The President—"The question now occurs on the original resolution as amended."

The original resolution, as amended, was adopted.

The chair appointed Mr. Charles Cooper, Mr. Ralph W. Pope and Dr. Otto Moses as the committee.

Mr. H. W. Pope—"I was appointed chairman of a committee yesterday on the matter of electric-light rates. After a discussion of the subject, we decided that, in view of the fact that we could not get any record that could be put in the minutes of this meeting, that it was not necessary, perhaps, to report, if the association would give this committee, or some other committee, power to act after the meeting of this convention. The intention is to get as nearly a correct list of rates and general statistical information of the various electric light companies as possible."

Mr. Weeks—"I move you that the committee be made a standing committee, and report at our next convention six months hence."

The motion was carried.

Mr. De Camp—"I have a paper in my hand that was adopted by the Philadelphia Company in making their reports showing the cost of their operations on these particular items. I think that we can get a very great deal of valuable information if every company would adopt the same form or some other form. That would entail a great deal of labor which I would be perfectly willing to devote to the subject if I felt that I would be supported by the members of this association—if there is a feeling on the part of the members of the association that they will co-operate in this thing. If we cannot have the co-operation of the members, I do not propose to undertake it."

The Secretary—"The president appoints the following Committee on Transportation:

"For the East—J. F. Noonan, Paterson, N. J.; Henry D Stanley, Bridgeport, Conn.; James English, New Haven, Conn.

"For the South—L. M. Fishback, St. Louis, Mo.; Mr. Yarbrough, Nashville, Tenn.

"For the West—George Wadsworth, Cleveland; S. A. Duncan, Pittsburgh, Pa."

The President—"Before a motion to adjourn is made, I wish to state to the convention that the secretary, Mr. Rhinehard has mailed to the insurance companies of Baltimore an invitation to be present to-morrow evening at four o'clock, when Mr. Woodbury will present his paper on "Electric Lighting and Insurance." I desire to state that Dr. Moses has brought with him to Baltimore an incandescent lamp, which, in my judgment, it will be very advantageous to the electric-lighting men present to examine carefully. I would be glad, before the convention adjourns, if Dr. Moses could be induced to bring the lamp into the convention, and make some explanation in regard to it. The first paper taken up upon the reassembling of this association will be the matter of underground wires. It will be a long session, and I hope the gentleman who makes the motion to adjourn will make the recess long enough to enable the gentlemen to recuperate."

Mr. Ralph W. Pope—"I have several letters here which I would like to dispose of."

The President—"These letters are replies to invitations to honorary membership sent to prominent gentlemen in Europe and elsewhere. If the gentleman reads the name of the writer, and, whether it be an acceptance or rejection, then they can go in the report."

Mr. R. W. Pope—"They all accept the honor. They are Sylvanus B. Thompson, London; R. E. Crampton, London; Z. T. Gramme, Paris; J. Hopkinson, London; Prof. Geo. Forbes, London; Joseph Wilson Swan, Launceston, England; John T. Sprague, Burlington; and Edward Hospitallier, Paris."

The convention then adjourned until four o'clock in the afternoon.

Thursday Afternoon Session.

The convention was called to order at four o'clock—Mr. H. M. Cleveland, vice-president, in the chair.

The secretary read the following telegram:

NEW YORK, Feb. 11th, 1886.

J. F. Morrison, president, and others:

Please accept sincere thanks for your invitation to be with you to-day or to-morrow. My warmest sympathies are with you in any good works that will serve as a genuine benefit in developing the business of electric illuminating and strengthening the financial interests of the local companies. As a commercial business, electric illumination is fully established, and only requires honest, conservative and loyal work, coupled with unity of action to place it upon as solid and enduring a basis as the gas interests of the world have hitherto occupied. I delayed answering this morning, hoping I could manage business engagements so that I could be with you. I found it impossible, and now send you greeting, and hope you will so conduct your deliberations as to realize all the benefits anticipated when the association was formed. Above all things, avoid rivalry and jealousy in discussing the various systems and methods, which is so common among the manufacturing or so-called parent companies, many of whom seem to act as though local companies were mere servants, and competition by younger and less pretentious concerns a crime. Be sure and officer your association with your ablest and most earnest men who are loyal to the business. Simply desirous of seeing the survival of the fittest, I am, respectfully, EDWARD H. GOFF.

The manager of this company, who is a friend of mine, says if I will add a few more lines he will give me a pass, but I have declined out of sheer consideration for the convention. EDWARD H. GOFF.

Mr. De Camp—"I move to amend Article IV. of the constitution by striking out after 'president' the word 'three' and inserting 'two,' making two vice-presidents of this association."

The amendment was adopted; also a motion that the chairman appoint a committee of three to nominate officers for the ensuing year.

Mr. Cooper—"I have a resolution from the Committee on Standard Gauge:

Resolved, That the new standard English gauge, as officially adopted by the National Telephone Exchange Association, be and is hereby approved by the National Electric Light Association, for the purpose of insuring uniformity in the mutual understanding of orders between manufacturers, dealers and consumers of wires for electrical purposes.

Resolved, That the members of this association engaged in the manufacture and sale of wires be requested to incorporate in their catalogues and price-lists the stipulation that the standard gauge approved by the above associations be understood as applying to all orders, unless otherwise specified either in quoting the prices or shipments.

The resolution was adopted and the report of the committee accepted.

Mr. H. W. Pope—"I wish to offer the following resolution:

Resolved, That this committee, or its successor, be empowered and requested to confer with other associations similarly interested, with a view to the legalizing by Congress of such standard gauge for guidance in the preparation and enforcement of contracts.

The Chairman—"The chair will appoint, as a committee to nominate officers, Mr. De Camp, of Philadelphia; Mr. Gilbert, of New Haven, and Mr. King, of Minneapolis."

Mr. Weeks—"I have noticed from time to time that there is considerable doubt as to the proper pronunciation of the word dynamo. It is variously pronounced dy'-namo, din'namo and dynam'-o. Now, I think it comes within the province of this association to decide upon that matter. The leading principles of pronunciation are, first, derivation; second, euphony; third, ease of pronunciation. By derivation this should be prodin'namo, as it comes from the Greek word *dunamis*, which means power. So far as euphony is concerned, it makes little difference; but so far as ease of utterance is concerned, it makes a good deal of difference, the majority being in favor of placing the accent on the first syllable. I offer a resolution that the pronunciation of that word be established by this association as dynamo, sticking to the Greek."

Dr. Moses—"I think the point is very well taken. The Greek word from which that is derived is *dunamos*. The accent is on the first syllable. So that if we wish by analogy to use the word, approving the derivation from the Greek, we should as near as possible adopt the Greek pronunciation. We say din'amite. We should say din'amo, as it is derived from the same root. I should think we could adopt that, not by direct action on the part of the convention, but by convention, if you please."

Mr. Cooper: "I move as an amendment that instead of adopting the Greek pronunciation, as we have not many Greeks with us, that we adopt the American pronunciation—dy'namo." The motion prevailed.

The Chairman: "The Chair will continue by appointment the committee of which Mr. Cooper is chairman, to confer with the telephone people to procure the necessary legislation called for by the resolution."

Mr. Ralph Pope read the paper prepared by him as a report on the subject of "Underground Wires," and at its conclusion said: "I have no information as to the reliable working of these different systems, as my investigations were conducted in such a way that it was hardly possible to get much information as to that. To determine on the general character of the work, it occurred to me that there might be gentlemen present in this convention who are familiar with some of the systems and who might be familiar with some of the troubles that were encountered, and therefore I haven't gone into the question of their reliability, because I knew nothing about it. I simply stated the facts as I found them. The drawing which I referred to, accompanies this paper, and is open for inspection."

Dr. Moses—"I listened to the paper of Mr. Pope with much surprise, because the convention cannot begin to conceive the labor he took in gathering the facts upon which he based his generalizations. I happen to be in a position myself to know of his assiduity in following up this question, and when he says there are one hundred different plans, that means that he has investigated one hundred different plans—very different, indeed, from reading the statement. It required his attention for many days, under great inconvenience occasionally, in order to gather that knowledge, which was epitomized in that way. The subject is one that is new, and, of course, every one that had anything to say on it presented plans before the Underground Commission in New York, that being the point most prominent for the inventor. The Underground Commission examined all these things, and it is really surprising what ingenuity has been expended upon them. Looking upon it philosophically, before the actual demand for underground systems arises, we find there pretty much all the necessary material on hand. There are some companies, however, who have had the courage to put this thing into actual practice. Notably, the Philadelphia company of which he spoke, and the one in Chicago, the Dorsett company, I believe. It may be interesting to the convention to know that the problem is a very difficult one. There is steam heating to be overcome. There are gas pipes that thread their ways most tortuously under every street. Subterranean New York is getting to be something like subterranean Rome. There are layers of gas pipes—those that have been cut off and neglected, and those that have been twisted away by some other companies who found them in the way; altogether, there is a perfect net-work combined with the sewer system, water system, and others, that makes it a very difficult problem in New York to handle. Any sys-

tem that is to be adopted there, must be one of a combined character, though not necessarily a system that can be carried out in its entirety in every street. However, there are some systems that could be very largely introduced. Then, again, in other places it would be necessary to combine. The problem, if solved in New York, and they promised to do it very soon, will, I think, very much facilitate those who wish to put down an underground system elsewhere, because this combination system, if it is introduced, there, will give all the necessary information, and I think that members of the convention, who have that at heart, can possess their souls in patience, in the meantime, leaving very well alone.

Mr. De Camp, of Philadelphia, said they had tried three methods, and all had failed. One party had been told that certain material he had in there was a good insulator. We said go ahead and try it, and it turned out as we thought it would. The other was presented by a man, as I understand, of considerable knowledge in that direction, and for that reason we had a right to expect some success from him.

Mr. King—"I would like to ask Mr. De Camp what he knows of the running of lights on wires run through a conduit."

Mr. De Camp—"I do not see how and where a conduit is going to very materially, until we get a wire to go through that conduit with insulation of itself irrespective of the conduit, impervious to all the influences which it may be subjected to underground. I think we have first got to find that, and when we have found that, to get to work and adopt a conduit or some methods of conveniences putting those wires underground. Another thing. We run down a street sixty feet wide. Suppose you can put that conduit in the center of the street. When I say a sixty-foot street I mean the Philadelphia street, which is sixty feet from curb to curb; then you have twelve feet on each side. Then you have forty-two feet from your conduit to your house, if you have the conduit in the center of the street. Then we have got to have something of an insulator on our wire that will stand underground. We could not afford to build miniature conduits from the conduit proper to the house. If we did, the mileage of our miniature conduits, as I call them, would exceed our main conduits by a great deal; so that must be taken into the calculation. Now the method used in Philadelphia, I think, is generally to put an ordinary gas pipe around the wire. Now, if the gas pipe has anything to do with it, why not dispense with the expensive iron conduit, because they are in sections and broken up by the ordinary gas pipes. I think that that decides that there is no particular merit in that particular conduit, so far as helping the insulation of the wires is concerned. In many cases they have simply taken the wire which was in the main already; one of them was a wire insulated, covered with a lead casing. I do not see why that would not answer just the same purpose as a pipe. But I cannot see anything in the conduit. When you discover something that is absolutely reliable, as an insulator, you may be required to adopt some entirely different form of conduit from what has ever been devised since. In Philadelphia, I think, the top of the conduit is probably at an average of about 15 to 18 inches. We have a Board of Supervisors in Philadelphia, appointed last year, and it has passed a resolution that no conduit shall be laid less than two feet below the surface. In Chestnut street for about two-thirds of the way from Broad street down, there is not room, if I am properly informed by the survey department, to lay a six-inch pipe. There are two lines of water pipe, two lines of gas pipe, a sewer, and the present conduits there. There may be something else, I don't know. That is the case in a great many streets. Take a street like Park street, which is very broad; there may be room there. We have a peculiar city government. It is the only one the Lord ever made. They have a peculiar way of taxing the people there. We have gas works which belong to the city. I understand there is only one other city in the country that owns its own gas works. The gas company now have agreed to furnish the city with light for nothing, but when they were charging for it they charged at the rate of of $15 per lamp-post, assuming it to be a five-foot burner, and in the same report of the gas trustees they put down the cost of each city lamp based at $28 50. Now the city owns those, and they claim it is a great thing, but the result is that the private consumer has to pay enough to make up that difference. The City of Philadelphia have passed, I suppose, six or eight ordinances on the question of underground wires, and when the original ordinance was passed fixing the time for putting the wires under ground there was an amendment to that ordinance that the ordinance should not provide city wires. Some one asked, why so? Why, the city hasn't got money enough, was the reply. They had a large mileage of wires, but the outlying wires were not in the section So far as their main lines were concerned, there is no reason why they should not bury them. They have always exempted themselves from the different ordinances that were passed."

Mr. Hotchkiss—"I do not think there is a doubt in the minds of the gentlemen present but that wires can be placed underground and made to work successfully, provided a proper quantity and quality of material is used. Whether the investment will be remunerative cannot be regulated by some town in the State of Wisconsin in comparison with the City of New York or the City of Baltimore. I move you, sir, that the report of Mr. Pope be placed on file and accepted." This was done, the chair stating that all papers were filed.

Mr. King, of Minneapolis—"In our locality just now it seems to me that there are various objections to a conduit system of any kind It seems to me that a conduit must of course be rigid, and any disturbance of the soil either by force or by the breakage of water pipes would endanger it of course; and in our climate especially, where the frost during the winter prevails down toward that point which the universalists don't believe in, it would be a very expensive thing to lay a conduit. Our frost gets down eight or nine feet sometimes, and I agree with Mr. De Camp that if we go underground at all, the conduit seems to be a useless thing. I think we ought to stay on top of the earth for a while longer."

Mr. Callender—"I begin to think that Mr. De Camp is somewhat in the position of the evil spirit of underground wires. In every experiment that Mr. De Camp has told of that has been undertaken in Philadelphia, the result, he informs us, was in every case a lamentable failure. I do not think it is quite creditable to engineers or electric light people and those interested in the subject that the statements go forth from this association that it is impossible—that gentlemen here have experimented with underground wires and find it quite impossible to run their arc currents underground. These are the facts that a man would gather from listening to Mr. De Camp to-day, and at our last meeting in New York. I do not think any of you who have given any careful consideration to the matter of what is necessary for underground wires, as Mr. Pope evidently has done, from the very careful paper he read to-day, but must come to the conclusion that two things are necessary before you can get an underground circuit to work satisfactorily. It is not sufficient to get an insulated wire and bury it in the earth. An insulated wire will not turn a pick or other instrument with which it may be struck, nor can it by any possibility resist the action of stones or sand or any similar material that will be found in the earth. You have got to provide yourself with a conduit and with an insulated wire. We completed a plant in Washington, in November, for arc lighting. It was for the United States Company for their new station near the capitol. All the wires that come from the station go from one spot, overhead to a pole, and from there the whole of the wires go underground. Most of them go two-thirds of the way up Pennsylvania avenue and some of them go up through the capitol grounds to the capitol. There are in the neighborhood of twenty miles of are wire that have been working underground both in the United States and Thomson-Houston systems. Tests have been taken of those cables recently, and they are perfectly satisfactory. There can be no deterioration in a system that is thoroughly well-worked out and thoroughly well-laid. I do not wish it to go from the association that the underground wire question is one of which you are afraid, of which you cannot see any successful ending and of which you are afraid financially. The calculations that have been gone into by those companies who have gone underground on any reasonable scale show that it is economy to do so. I refer you to an article that appeared last week in the ELECTRICAL REVIEW, describing Mr. Hapgood's experience in Detroit. There he finds it is economy to use his wires underground in the Dorsett conduit."

Mr. De Camp—"I do not wish to be personal, but the circumstances are such that probably it may be so considered. When you referred to this matter, I think I understood what you meant—that the cable you put down for the Brush Electric Light Company was injured through neglect on our part or some misjudgment in laying the cable. I brand that as false. And when you come to me and show me a place as big as a knife edge and say that was the fault of a mechanic, I say your judgment is not worth anything. The very fact of the cable breaking or a leak coming there has destroyed any possible evidence of the cause of it. Any man who has ever connected light wires, knows what that is. Every man who has come there and made experiments has had proper attention paid to him. Every facility has been offered to him honestly and in good faith, save one exception—omitting those two which I have not heard from—in every instance our co-operation had been abused. We have been abused in one way or another and I consider the remarks of Mr. Callendar an abuse. We have been abused by all except one man who, when he failed closed his mouth and went away, and he acknowledged his failure. Now, we have made those experiments for, I suppose, fifteen people. We do not decline to do it yet. But we have not met with the courtesy from the people to whom we have afforded those facilities that we have extended to them."

Mr. Morrison "No electrical engineer would dare to stand on this floor and say that it was an impossible thing to place the electric lighting wires underground and have them successfully operated underground. It is possible and it is feasible. The enormous cost of such an operation, however, stands as a bar to the work, while the men who would be called upon to invest their money look upon it as an experimental operation, experimental in this country to a certain extent. The fact that electric lighting wires and all other classes of wires are being operated underground, and successfully operated, settles that question. In the city of Washington where they will not permit the putting up of any new lines overhead and where our people are compelled to put their wires underground. they are operated with success. In Europe most of the wires of the large cities, in one shape or another, are operated underground or in conduits that are provided for wires and for other purposes at the same time. The history of these underground matters on the other side of the water is the history of the telegraph and of electric matters generally. It is not worth my while to go into it. It has been all talked over, so that the question has about settled itself. Our case—I now speak from the electric lighting standpoint—is about this: In the city of New York the most searching investigation is being made in this direction, not for the purpose of settling the question as to the possibility of placing wires underground, but as to adopting the best method already provided for that purpose. We take it that it would be unfair to the men who have put their money into this business and who have plants of overhead wires, to compel them to adopt any system until some system has passed under this rod in New York, and this question has been to some extent settled, not only by the ordering of the wires underground, not only by providing a means of placing the wires underground, but by giving us the right to wait a reasonable time after such system has been adopted by the New York Subway Commission to allow us to see whether it is a success or not. I would like to treat every system fairly. I have tested under my own hand two plans for underground wires, one was a system of placing a bare wire in a bed of bitumen, Rittenhouse's plan it was called. He had a lot of buttons he strung on a wire and put the wire and buttons in the asphalt. I told him the buttons were of no account, but he put cubes of terra cotta on the wire and buried the wire in the bitumen. Now that did not receive exactly fair play. As I passed through the prison yard, where the experiments were being made, and out again on Van Buren street, a distance of about three-quarters of a mile, I saw in going along that the workmen were dropping the sand in as the bitumen was being poured in. The line operated for about two or three months and then it began to show faults and grew worse and worse until we had to abandon it. The other experiment was made in the same neighborhood by me with a cable covered with kerite. The wire was buried underground and carefully watched by myself and Mr. Orford. That cable was carefully watched day by day and it showed little or no signs of deterioration. We kept in underground, kept it in actual service, working it in a circuit along with about forty or fifty miles of No. 4 overhead wires. We coupled our circuit up. All our overhead wires are made up of No. 4 Brown & Sharpe's gauge. At one time you have a circuit with 60 lights, and in three or four minutes you have no more than 20 lights on it. Take, say, three, four, five, six, seven, eight, nine circuits and loop them together one after another, and in that way we have frequently worked through 40, 50 and even 80 miles of wire. This was a stranded cable kerite insulation on it. We were working through this cable all this time and through the varying distances of wire coupled up in these circuits, and we operated from 20 lights to 60 lights over that mileage of 40, 50 or 60 miles of circuit, including this cable. We had no difficulty from the cable and only removed it when we had to use the locality for some other purpose. It was in that service, I judge, for some eight or ten months, without showing any signs of deterioration. These are the only two experiments that I have seen made.

We do not want to place our wires underground at all, to begin with. In the second place we insist on fair play on the part of legislators; that they will keep their hands from us until something has been reached by those who are engaged in solving this problem—I now refer to this same Subway Commission—until they have gone before the world with some settlement of this difficulty from their standpoint. After they have done this and the plan is adopted, then give us a reasonable time to see whether that plan is a proper one. Then after that it is perfectly proper for the authorities to come along and say, 'There is a plan; go on and use it.' When the time comes, I do not think you will find any difficulty from any electric-lighting man on that score. There is less difficulty from our side of the house than from the telegraph people, because the placing of an electric-lighting wire underground is very little more expensive than building it overhead. We do not want to avoid the underground business particularly. All we want is for them to say to us, 'Here is a system properly devised and tested, and here are the results.' The Callendar Insulating Company have got work in Washington, and up to the present time, I have it by authority from Mr. McAlees, the superintendent of the Police and Fire Telegraph of Baltimore, that it is giving good satisfaction. The wires are being placed underground in conduits, and they report good satisfaction from that

source. In Baltimore the mayor of the city takes strong ground in favor, not of placing the wires underground particularly; you cannot make a telegraph pole or an electric-light pole an ornament; they are more or less a nuisance on the street, and so those interested in the appearance of the city would like to get rid of these wires. The mayor has used pretty strong language in the matter of underground wires. He says: 'There are no two opinions in this community concerning the necessity and expediency of an early abolishment of the overhead city wires now in use, the expansion of which has become so great as to be justly and generally regarded as an intolerable nuisance, while the wires themselves are terrible to the imagination as suggesting an increased loss of property and life in case of fire. The poles are an incumbrance to the sidewalk. They form a mass of unsightliness,' etc. He expresses there about the sentiment of it. You have these quotations from Mr. McAlees, who is present in the room now, giving the result of his observation in the different cities where the underground system is used. Upon that, legislation will be asked in this city looking to experimental work, probably, so that in the coming year you will doubtless have the result of a good many practical experiments laid before this association. Sometimes you find the chief engineer of the fire department making a report about the danger to the men in his department from the electric-lighting wires, but none of these are true. I never knew a fireman to be killed by shock from an electric light wire. I never knew one to be injured in that way. You see extraordinary stories printed in the newspapers once in a while about this, that and the other thing, and the chief engineer of the Baltimore Fire Department is no exception to that general rule. He puts himself on record in a report (which will be preserved in the archives of the city), saying that numbers of lives have been lost through the fire-alarm telegraph. For those of you who have not the honor of an acquaintance with this gentleman, I beg to say that that is about on a line with the general statements he makes with regard to every matter, public and private. I do not know whether he would have sense enough to tell the truth if he knew how. But when you take a city official in as high a position as that, and permit him to display such malicious ignorance as he has displayed in the quotation I have given, it is time to infuse a little more brains and less muscle into the government of the fire department. I have got to leave this underground question with these few remarks. I think fair play would indicate a waiting policy on the part of the State and municipal governments, until the time has arrived when some solution of this question has been made by those engaged in endeavoring to solve it. I think that we should treat the case with grave consideration, and we should endeavor to treat every man who is engaged in this line of business with absolute fairness, because the man who really solves this problem, Mr. President—the man who brings before the public a real solution of this question—will be, to my mind, a public benefactor; and when that time comes, and the successful system is laid before you, and you can put your wires underground at a reasonable expense for plant and maintenance, there is not a man engaged in this line of business but will hail that with as much joy as will those whose æsthetic tastes are shocked by the telegraph wires and posts in the streets of the city." (Applause.)

Mr. Weeks—"In relation to what has been said, I would like to add a word, and it is this, that the attitude of the people toward overhead wires, reminds me of the familiar quotation, "Whether 'tis better to bear the ills we have, or fly to others that we know not of." It seems to me they do not stop to think of the consequences of placing electrical wires under ground. Take our own city, for instance, where we now have a gas company and water company, with rights to tear up the pavements of the streets, and lay down their mains, in addition to a very expensive sewer system. Now, to compel three telegraph companies, two district companies, an electric-light company and a telephone company, all to place their wires under ground, giving them rights to go upon the streets, alleys and avenues of the city, and to tear up the pavements, it seems to me that if the people sanction that, they have forgotten, or do not think of the consequences of such action. The sanitary view of the matter is a very important one. We would have all sorts of fevers and malaria there, and with our narrow streets and rapidly increasing business, our thoroughfares would become impassable, and with electric companies, the placing of the wires under ground would be but the beginning of the nuisance, because whenever there was trouble, there would be the necessity for extensive excavation. I endorse all that our president has said in regard to waiting. I think that is our true position. We should wait until there has been a suitable system found and it has been demonstrated to be such. Then, when that time comes, I will favor an underground system, provided the people, after an intelligent review of the objections to it, conclude that the objections to the aerial system are sufficient to warrant them in putting up with the others.

Mr. Ralph W. Pope—"I would like to say one word touching this question about the pride of the people. I think that that has been misunderstood. The way I have looked at it all the time is that the press, under some mysterious influence—we may not know exactly what it is, but we know it is there—has been very industriously manufacturing this public opinion, and advertising it; and as an example of that, just before leaving New York on a tour of inspection in connection with this business, I saw in the *Times* of that city a statement to the effect that while the commissioners of New York were wrestling with this problem, Washington and Philadelphia had already placed their wires under ground, and we started out, and found fully as many wires overhead, in proportion to the size of those cities, as there were in New York. A similar state of affairs existed in Chicago, although I believe some of the wires were to be taken down at the time I was there; but the facts were there. Instead of Washington and Philadelphia having buried all their wires, it was a pretty well understood fact, when they came to cipher the thing down, that there were actually more miles of wire under ground in New York City than there were in either of the cities we visited. There had been underground work undertaken by the telephone company and the Western Union company; and although none had been done by the arc-lighting company, there was an extensive system of incandescent lighting wires there, so that instead of being behind, New York was actually ahead. Of course, it is generally understood by citizens familiar with the streets of New York, that a great many wires are overhead yet. Another thing that is not generally understood by the actual promenader of the cities, is that, although the surface of the street may give you the impression that there is lots of room below, when you see an excavation made there, and see the net-work of pipes, crossing and re-crossing mains, branches and sewers, it is quite a difficult problem to find plenty of room in the streets of New York, that is, in the down-town streets, where the problem of burying the wires is, of course, more perplexing than it is up-town. But up-town it is a financial question. There are not enough wires there to make it worth while to put them under ground. They are no nuisance, and the new manager of the telephone company finds that there are practically no telephones above Thirty-fourth street. I was talking with him the other day about putting his wires under ground. I called his attention to the fact that the telephone service did not demand, and could not pay for any system of that kind, in that part of the city."

Mr. Henry W. Pope—"I had the pleasure of serving on this New York underground committee some time ago. At the corner of Broadway and Wall Street, in the city of New York, there are forty-five different underground structures. Now, this committee went pretty thoroughly into the subject, and they came to the conclusion that about the only thing that could be used in the city of New York was a tunnel, and I believe because they made such a recommendation as that it was given out in the papers that they had been influenced in one way or another to make such a report. Nevertheless, I think that anybody who has looked into the subject comes to the same conclusion. Now, a very similar thing in connection with this underground system—in London, where they have had this underground system a great many years, they have a great many housetop wires, and it seems to me that in that country if the thing had been entirely practicable, they would have refused to have granted any such permission."

Mr. Cooper—"As I understand it, there is not at the present time any question before the convention, for the reason that all papers similar to Mr. Pope's, and his among them, are accepted and placed on file by the association. I would, therefore, offer the following resolution:

Resolved, That it be adopted as the sense of the National Electric Light Association, that up to the present time there has been no system of underground wires that recommends itself for adoption by the electric light companies of America; and that unless something more feasible is presented, that we earnestly protest against any enforcement of an underground system, until it is proved beyond doubt that by such adoption, the usefulness or life of the electric companies is not jeopardized, and that we believe that up to the present time, all the underground systems are more or less experimental, and that it is an injustice to expect the electric light companies to adopt any system that has not proved itself practicable not only in the electric, but in any sense of the word.

The president here took the chair.

Mr. Hotchkiss—"I suggested to the president the filing of the approval of the report submitted by Mr. Pope. The resolution as presented by Mr. Cooper I do not think should be placed upon record. The question is not one of means, ways or ability. It is a question of cost, gentlemen. It will pay some men in certain localities to put up a fourteen story building, and others build a one story wooden shed. Some men dig a cellar four stories under the sidewalk. Others have none. If you, gentlemen of the Electric Light Association, can receive an adequate return for the service that you give to the public or to your customers, you are warranted in putting your wires under ground. If you cannot get such a return and your income will not permit you to make the expenditure, that is the only question you have got to decide. Science and ability will give you the means of quickly satisfying your wants."

Mr. Cooper—"That is just the point that is meant to be covered by my resolution. As I understand this underground question, it is an enforcement of the seventeenth-story building that Mr. Hotchkiss speaks of, with five stories under ground, where one story would do, and I say we do not want to be forced to build such a building unless it is absolutely necessary."

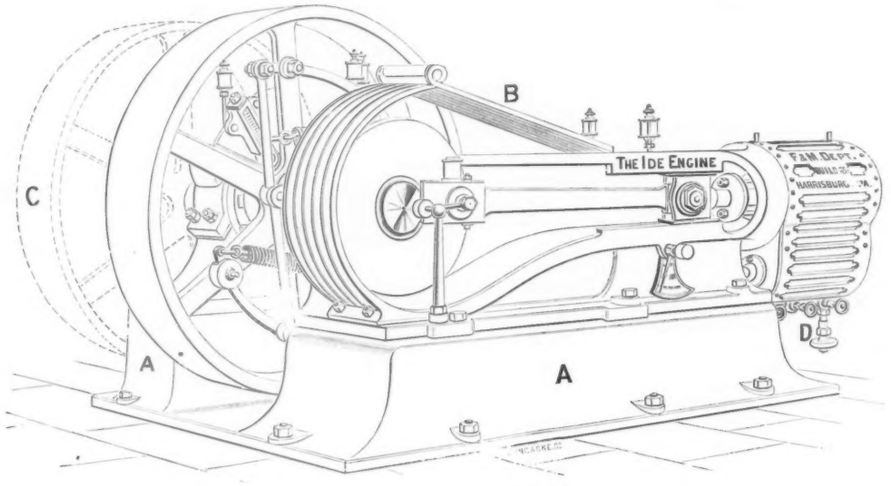

FIG. 2.—SIDE VIEW OF THE IDE ENGINE.

Mr. King—"Can Mr. Pope tell us to what extent electric light wires are run through tunnels in Chicago?"

Mr. Ralph W. Pope—'There were two gentlemen from Chicago associated with me on the work of this committee, and I relied upon them to give some further information to the convention in regard to the fact that Mr. King desires information upon. Those gentlemen are not present and I can only speak from recollection without having thoroughly gone into it. As we stood at one of the street corners in Chicago, I was told that there were eight different arc-light systems that could be seen from that point. Whether that is so or not I cannot say, of course, not being familiar with them. There are certainly several large systems in operation there, but they are not carried out to the same extent that they are in other cities of the same size. They are more local in their character—isolated plants. I presume that some of the gentlemen present—Mr. Hotchkiss and Mr. Callender, perhaps—who have done some underground work there, can give you the information you desire."

Mr. King—"When I am at home I learn that in the East the wires are buried. When I am in the East I learn that at home the wires are buried."

Mr. Weeks—"I move that the resolution be referred to a committee of three to report at our next session." The motion was carried.

The President—"I will appoint on that committee Mr. Weeks, Mr. Cooper and Mr. Hotchkiss." Mr. Hotchkiss asked to be excused and Mr. Ridlon was appointed.

Resolved, That a committee of three be appointed by the chair (of which I shall not be chairman) to consider the legal relation of electric lighting to insurance; the legal relation of electric light companies to the public; the legal relation of electric light companies to telephone and telegraph companies; and the relation of electric light companies to the patent system.

The resolution was adopted.

The President—"The chair will appoint Arthur Stewart, of Baltimore; A. J. De Camp, of Philadelphia; and Ralph W. Pope, of New York, as that committee."

The convention then adjourned until ten o'clock on the following day.

(Friday's proceedings, summarized below, will appear in full in our next edition.)

Summary of Friday's Proceedings.

At ten o'clock the convention assembled, and, on motion of Mr. De Camp, the following amendment to the by-laws was adopted:

The officers of this convention shall be a president, two vice-presidents, a secretary and treasurer, and six members as an Executive Committee, four of whom shall constitute a quorum. All officers shall be elected by ballot for one year, or until their successors be elected and qualify, except the secretary, who shall be appointed by the president; all vacancies to be filled by the Executive Committee.

Mr. Weeks presented the following report on the resolution offered by Mr. Cooper:

Resolved, That it is the sense of this association that no legislation looking to the placing of wires underground should be enforced until it has been proven beyond doubt that by such a n act the usefulness or life of the electric light companies is not jeopardized, and, further, that it is the sense of this association that up to the present time no such underground system has been put in practical operation.

Mr. De Camp handed the following resolution to the secretary, who read the same to the convention:

Whereas, The last two meetings of the National Electric Light Association have been held in the East, and, as the time of the next meeting is in the month of August,

Resolved, That the Executive Committee be requested to call the next meeting in Detroit.

WILLIAM H. FITZGERALD.

The resolution was seconded by Mr. Ridlon and carried.

Mr. E. R. Weeks read a practical paper on "Operating Expenses." This was followed by a very lengthy and deeply-interesting discussion on "Incandescent Lighting," Dr. Moses opening, followed by Professor Rowland, of Johns Hopkins University; Lieutenant Duncan, of the U. S. Navy; Messrs. Robinson, Upton, Woodbury, Morrison, De Camp, Swift, Rorison, Kerr, Smith and Cooper. Prof. Rowland, in his remarks, alluded to the machine he constructed in 1868, saying that he was too young at that time to secure appreciation of his work, or he should have had it patented, and it would have been adding to his funds at the present time. Lieut. Duncan gave an account of the Franklin Institute tests of the life and efficie cy of incandescent lamps.

Mr. Frank Ridlon, of Boston, read a paper on "Carbons and Globes." On motion, a committee was appointed to investigate the carbon question, with a view to establishing a standard test to decide the quality of carbons. The committee appointed consisted of Messrs. Cooper, of Brooklyn; Ridlon, of Boston, and King, of Minneapolis. The association then adjourned.

When the meeting was called to order in the afternoon, a letter from Mr. William F. Swift, of Cleveland, was read, referring to the choice of the next place of meeting. A resolution was adopted to appoint a committee, composed of representatives of each electric-light system, to consider the relations between the sub-companies and the parent companies, with a view to their more amicable adjustment.

One of the most important features of the session was a paper by Mr. C. J. H. Woodbury, of Boston, on electric lighting and insurance. It appears in full. A number of leading underwriters who had been invited to be present were in attendance.

The Relation of Electric Lighting to Insurance.

The competition forcing the struggle for existence in modern civilization is not shown anywhere in a more marked degree than in the demand for time. Like the dying royal reprobate, it cries, "Millions for a moment of time," and seizes upon every expedient which will add to the measure of time at its disposal.

Rapid transportation in shortening unavailable time, and artificial illumination in lengthening available time, minister to the necessities of commercial and home life, and form our greatest industries. Transportation requires more capital than any other industry, about 20 per cent. of the live capital of this country being invested in railroads. The several methods of artificial illumination and their kindred industries are second on the list, requiring somewhat over 2 per cent. of the invested capital.

Both of these subjects have received the careful attentions of legislators, and these interests have reached such magnitude that the most carefully-phrased legislation has been enacted to defend the individual against the undue exercise of corporate power.

The numerous and continuous injuries to person and to property, in spite of all precautions, have caused the most stringent statute laws relative to the production of artificial light. Although differing in the several States, all relate to similar measures, such as, oils for illumination must not exceed certain fire tests, must be stored in covered buildings, cannot be left near the highways; and numerous regulations control matters relative to transportation and sale, and also to its use on railway and coast and internal marine lines carrying passengers at night.

The varied legislation in respect to burning gas fixes minimum limits as to luminosity, percentage of poisonous gases, the rights and responsibilities of gas companies in the franchise permitting them to enter upon and open highways; and one State, at least, possesses a law which can be constructed as forbidding a gas meter operating as a perpetual motion.

This class of laws has been a necessity in the endeavor to reduce the casualties resulting from the use of artificial light; and, wide as they are in scope and exact in details of enforcement, the painful consequences following the use of oil and gas show that these laws fall short of their purpose.

At this time we have occasion to consider only one of the several methods of illumination, and it is remarkable that electric lighting which is in general use throughout the country, and containing, like all other forms of energy, well-known possibilities of danger, has never been the subject of any State law yet in force. City ordinances have been passed for a purpose, and to no purpose. The questions of the safety of electrical illumination have thus far been settled by the electric interests without intervention of the law; and I venture to state that the instance of an industry voluntarily assuming its self-government for the direct weal of other interests is without parallel. When electricity was first applied for illumination on a commercial scale, it was a business without precedents; everything was new, crude and undeveloped. The leading inventors were absorbed in the solutions of their problems; no trained assistants were available; the books contained nothing on the modern application of dynamo currents; the scientific schools could teach but little except general principles; telegraphy had but little in common with the subject beyond its terminology; so that neither technical graduates nor telegraphers were prepared to enter upon the work without further training. Mechanics had much to learn in matters of construction of apparatus; the proper manufacturing supplies were not in the market, and the best steam-engines for meeting the conditions for the best operation of dynamos have appeared since that time. The development of the whole business required invention, education and organization from one end to the other.

Considering the nature of the difficulties which were surmounted, the wonder is not at the mistakes, but at the success.

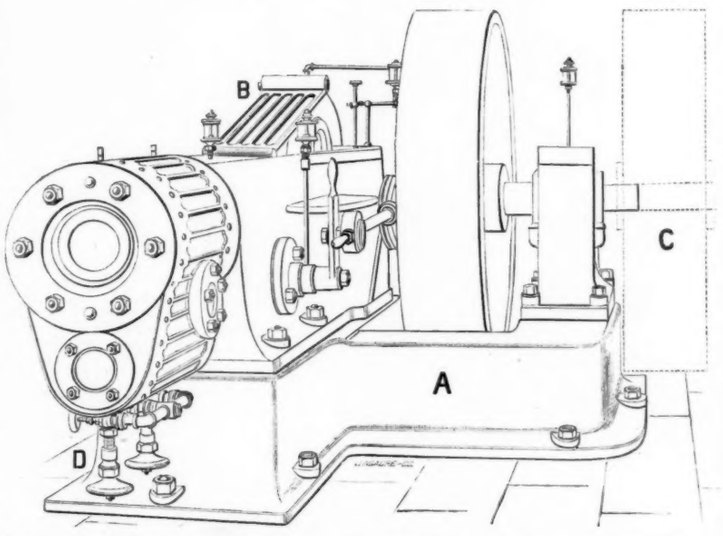

FIG 1.—END VIEW OF THE IDE AUTOMATIC ENGINE, MANUFACTURED BY THE FOUNDRY AND MACHINE DEPARTMENT OF HARRISBURG CAR MANUFACTURING COMPANY.

One of the elements naturally disregarded at the outset in the rush to invent, make and install the apparatus, was the possibility that electricity might like other methods of lighting become a cause of fire.

Soon numerous fires served as a reminder that electricity as applied at that time possessed no immunity from consequences similar to those resulting from other methods of illumination, and public opinion for a time had a tendency to veer to an extreme position—even farther from the truth than its first assumption that electricity could not produce a fire.

A careful examination of the circumstances attending a number of these fires and a repetition of these conditions upon electric lighting plants served as the basis of the regulations for the use of electric lighting apparatus prepared by the writer for the Factory Mutual Insurance Companies, a little more than four years ago. It would have been impossible for the work to have been carried on, had I not received the most cordial co-operation from the electric light companies; and the electricians at the head of these companies freely gave of their experience, in the endeavor to determine the facts at issue.

The results of this work warranted the opinion that a well arranged electric lighting plant was the safest method of illumina-

(*Continued on page* 10.)

ELECTRIC LIGHT NEWS

—— The electric lighting system at Plymouth is to be increased to 125 arc-lights, and an incandescent machine is to be put in for small consumers.

—— The Mather Electric Company, of Hartford, Conn., have received the order for a 400-incandescent light plant for one of the mills of the Hartford Carpet Company at Thompsonville, Conn.

—— The Green Bay and Fort Howard Electric Light Company, Green Bay, Wis., has been organized with a capital stock of $20,000. George W. Lamb and others are the incorporators.

—— The Johnson Carbon Company, North Adams, Mass., has just turned out its first product of carbons for electric lights, to the number of 20,000. They have a complete set of apparatus, furnaces, presses, etc., and will be able to turn out from 5,000 to 10 000 daily.

—— Mr. D. Simon, a clothier, of Altoona, Pa., has introduced the electric-light into his extensive stores, using the Westinghouse system. The Westinghouse is also putting a dynamo of 300 16-candle-light power in the paper mill of Morrison & Cass, at Tyrone. It will be ready for operation this week.

—— Sacramento, Cal., wants more light. At a recent meeting of the city trustees a petition was read, signed by a number of citizens, as follows: "We the undersigned taxpayers and voters do protest against the ignoring of our former petition, and now demand that an electric mast be erected on Fourth and T streets, as that is a central point in a thickly settled, unlighted portion of the city." Street Commissioner Nielsen stated that masts were to be located at Fourth and K and Ninth and R, which would light the section referred to by the petitioners.

The Ide Automatic Cut-off Engines.

The REVIEW presents to its readers two cuts of the Ide engine, manufactured by the foundry and machine department of the Harrisburgh Car Manufacturing Company, of Harrisburgh, Pa. We regret the crowded condition of our columns prevents giving an extended notice of this very desirable engine. The above company is the sole manufacturer of these engines in the Eastern, Middle and a portion of the Southern States. The construction of the engine is very simple and substantial; all malleable parts are of steel; crank shafts are of steel, and, in diameter, equal to one-half the bore of cylinder. Besides its very excellent general construction and design, a number of new features are embodied in this engine. To avoid the results of any possible accumulation of water in the cylinders, due to foaming of boilers or carelessness on the part of the fireman, explosion diaphragms are placed under each end of cylinder. These are in a direct communication with the cylinder, and in the event of a pressure due to the presence of water exceeding the normal conditions, these diaphragms will burst and immediately relieve the cylinder and avoid such disastrous results as knocking out the cylinder heads or crushing the piston. These diaphragms have in a number of instances proved their utility. Oil guards are placed over the crank, as shown at *B*, in Fig. 1, which not only adds to the appearance of the engine, but are very desirble features. An indicator dial is also placed on the front of the engine, howing at all times the point of cut-off, so that the operator can at a glance tell, without the use of steam-engine indicator, approximately the amount of work the engine is performing. Stationary oilers, with sight-feed, are provided for all the bearings, so that lubrication can always be attended to while in operation. These engines are invariably well finished, and the aim of the manufacturers is to secure the highest perfection possible in the steam-engine.

tion, and the experience of time has sustained that position.

The essentials for safety in an electric lighting plant are few and simple. In the presence of combustible material, arc lights should be enclosed in globes resting on closed stands with a raised edge, confining the sparks and copper, and some extra stop at the bottom of the lamp to prevent the lower carbon from falling in any contingency. The feeding apparatus at the lamp should prevent the formation of an undue arc in case of any disarrangement. Switches should be constructed so that an arc could not be formed by their use. The electricity must be confined to its metallic circuits and the conditions of its use controlled.

The regulations found necessary to specify these particulars in detail are of some length, but do not embody any other features. Experience has shown that they have served the purpose for which they were intended, for I do not know of any fire from electric lighting apparatus except where they have been violated.

The chief elements of danger are conductors of high resistance, generally formed by two earth contacts, and sometimes by a conductor between two wires of different potential. Such diversions of current are generally caused by water penetrating the insulation, and it is of importance that the insulation be waterproof, wherever there is liability of exposure to moisture.

The enforcement of these rules by the Factory Mutual Insurance Companies and the Boston Fire Underwriters' Union was based upon an inspection which was recorded upon the following blank, by underlining the items to be specified; spaces are left for negatives and the addition of notes of a more general nature; further remarks can be written on the other side of the sheet, where it is dated and signed by the inspector. Attention is called to items requiring correction, by an X in the margin.

For inspection use, these blanks are secured by rubber bands in a small portfolio the size of a pocket note-book, and after a record has been made upon them, they are filed away at the office.

Careful attention should be given to the importance of daily tests for ground connections, and for this purpose an ordinary Bell magneto is the most convenient apparatus. The electric bells and small galvanometers, with low resistance coils frequently used for his purpose, are not sufficiently delicate, as they cannot indicate a weakness in the insulation unless its resistance be less than ten to one hundred ohms according to circumstances.

The general average of electric plants have no place for the expensive apparatus and methods necessary to measure the resistance of the insulation of the system. Whatever method may be employed for permanent testing, the line connecting the electric light circuit with the testing apparatus and thence to the earth should have a spring switch, which could not be left closed, and thereby ground the circuit.

I have used for several years the portable magneto which I devised for the purpose of inspection testing. The shaft of the driving pulley is at right angles to the armature, and this allows it to be placed in a small flat rubber case, which contains two flexible steel reels each thirty feet in length, which serve as conductors between the circuit and the earth.

The value of this method of inspection which I have described is shown by the results following its adoption. In the autumn of 1881 and winter of 1882, 23 fires were caused by 61 electric lighting plants in mills insured by the Factory Mutual Insurance Companies in the eastern portion of the United States. The apparatus was inspected and the alterations necessary for safety, specified and carried into effect, and there has not been a single fire from electric lighting apparatus on this property since that time, although the number of mills using electric lights has increasing to nearly 200, and the average size of the plants greatly enlarged. From being a legitimate cause of apprehension on the part of the under writers, the hazard of electric lighting, in this field at least, has subsided into a matter of routine inspection.

There is a prospect of new matter at issue, which will tend to reverse the present conditions relative to safety in connection with the distribution of electric lighting. There is a widespread feeling of opposition to aerial electric wires, and several city governments with the intrepidity of practical politicians have passed ordinances decreeing that the wires must be buried.

In the present state of the art of supplying arc-lights from central stations to scattered clients, the execution of such measures, if rashly entered upon, would be simply prohibitory, depriving the public of the enjoyment and protection derived from thoroughly lighted streets, and limiting its use to those who have boiler, engine and complete electric lighting plant on their premises.

It is well known that the use of all underground electrical conductors is attended with special difficulties. The first transatlantic cable resulted in a failure through the efforts to operate it in a manner similar to a land telegraph line; the telephone companies have concentrated their best forces upon the problem, with indifferent success; the telegraph companies have not been idle in looking out for their interests in the matter, and one of them has been engaged in experiments upon underground wires for several years, without obtaining satisfactory results. The telegraph system, as Prof. Morse invented it, did not contemplate other than underground wires, and aerial wires were put up as a matter of necessity, where it was impossible to bury them on the stone viaduct of the Baltimore and Ohio Railway, at Relay Station, and the nine miles of wire buried along the right of way of the railway between Relay Station and Baltimore was abandoned, because the insulation could not be maintained, and an aerial line substituted along the whole distance. On this occasion, it is necessary to confine the consideration of underground wires to conductors of electric lighting currents, as being the only phase of the question germane to the objects of this convention.

Mr. Edison, with his inventive skill, supplemented by the immense financial resources of his company, has designed and laid a system of underground conductors for incandescent lighting from central stations distributing lights over a small area in the denser portions of cities containing his stations. It serves its purpose, which is to conduct electricity at a tension of one-thirtieth of that used on some arc lighting circuits. An insulation of sufficient resistance to be adequate for incandescent circuits would not be suited for arc lighting conductors. Mr. Edison invented that system of underground conductors, for the specific purpose of adapting it to his system of electric lighting, and relatively simpler, as such a matter may be than the invention of a feasible method of burying arc lighting wires under the present limitations of consumption, it may be noted that no other incandescent electric lighting interest has made any installation of any method of underground conductors. Portions of his central station circuits are above ground, as is the whole of his "village system" of lighting, and his "municipal system" is not only above ground but uses electricity at an electromotive force of 1,000 volts.

The distinctions between the conditions involved in the general problem of underground wires, and those of an incandescent system feeding a limited territory have been stated, in order that this specific case may not be cited as a reason why all electric wires could be treated in a similar manner.

Like all parts of an electric light system, the conductors, whether aerial or subterranean, must be insulated from connection with the earth. For underground wires, this substance must possess a wide range of physical properties, in addition to high electrical resistance; it must be uninjured by extremes of moisture or dryness, or variations of natural temperature; it must not be acted upon by sewage or coal gas; not rendered defective by strains due to settling of buildings or the impact of traffic; furthermore, it must be cheap.

In all other forms of electric apparatus, a fault or leakage is merely an interference to the operation of the system, but in electric lighting a fault includes all this, and the liability of as much injury to person or property as may be possible by the amount of energy diverted from the circuit.

The clothes-line system of overhead wires adds no beauty to the landscape, but that is no valid reason for its abolition, except to those adherents of Ruskin who may endorse his fierce diatribe against the railway system as destroying the beauties of natural scenery' by its cuttings and fills, its nerve-thrashing noise and black belched smoke, and above all the utter absence of lines of beauty in either roadbed or rolling stock.

The few instances where wires over buildings interfered with ladders of the fire department might have been avoidable by the further elevation of the wires or by their crossing the streets at nearly right angles. In the natural course of improvement the lines in cities are being changed from their scattered courses and systematized upon permanent fixtures high enough to carry the wires a reasonable distance above all roofs. Aerial wires certainly furnish the most ready means for electric companies to reach their customers, who are frequently distributed very unevenly over a city, and like all other seekers after trade, may at times conflict with other interests.

The network of wires over cities serves as the most efficient protection against lightning, these conductors by their great number, scattering the force of thunderbolts and conducting them to earth, on this account thunderstorms are much more destructive in the country than in cities.

As for personal danger, a lineman is in infinitely greater danger from gravity than from electricity.

I repeat that most of the fires from arc lighting systems have resulted in the diversion of the current by two contacts, one of them being a ground which had existed for an unknown time and the second being an accidental ground, generally of increasing resistance until it converted the electricity into heat whose temperature was high enough to ignite combustible material. When a ground exists anywhere on a circuit this ground is trying to form a second connection at the weakest point in the insulation anywhere on the whole circuit, irrespective of position. The one connection to earth may exist near the dynamo and the other in some building at the extreme portion of the circuit, or it may be only a few inches away.

When the conductors are secured to elevated supports, they can readily be kept free from all such earth connections and a casual inspection shows the places liable to defects, and the necessary changes can be made. With an underground system, this danger exists everywhere along the line, and is difficult of location and remedy, while the natural deterioration of material renders the hazard an increasing one.

The agitation of the subject has stimulated inventors, and the protection of the Patent Office has been invoked accordingly upon divers methods of covering and grouping wires to be laid in a trench, most of them devised on the Mede and Persian principle, inasmuch as when once laid away further changes would be unfeasible.

Many underground arc-lighting circuits have received faithful trials without obtaining satisfactory results which would warrant their adoption by any form of American practice.

In this connection, I wish to cite several instances where such trials have been made. A large contract for lighting a park was offered to an electric lighting company, upon the condition that the wires be placed under ground. An electric light company in Boston made preliminary experiments by laying 1,200 feet of one of their circuits under ground. The conductors consisted of No. 4. copper wire covered with rubber insulating composition one-eighth of an inch thick, and further protected by two thicknesses of cotton braid. The two wires of the loop were laid in grooves a foot apart in a plank laid three feet below the pavement, and covered by another plank. The resistance of the insulation of this circuit exceeded 90,000,000 ohms when first laid, but it diminished until the repairs made necessary by the frequent escapes, became so burdensome that this underground line was abandoned, and a different line laid in a wooden conduit, with cleats arranged so that the wires could not approach nearer than a foot to each other. This second line consisted of the same size wire covered by a rubber insulating compound and inclosed in a lead tube; and this wire, like the former one, proved a failure in the course of a few months.

The faults were caused by a disintegration of the insulation, entirely different from anything similar resulting from the use of the same kind of insulation above ground.

At these places the wire would become vaporized and attenuate, similar to a pair of arc-light carbons, the connecting filament becoming smaller until an open circuit was established.

In Philadelphia, the escapes from an underground system of electric arc-light wires on Chestnut street are believed to have been the cause of several severe explosions of illuminating gas leaking through the ground. On Delaware avenue, in the same city, an underground circuit with different insulation, received a careful trial, until the escapes through defective insulation in spite of numerous repairs, diverted so much of the electricity from the circuit, that the lights could not be maintained, and aerial wire were substituted. The temperature of these escapes was so great that the sand was partially fused in places, and if the lights had been inside of buildings, there would have been a liability of such points of excessive heat occurring in the presence of combustible material, with destructive consequences.

The result of a few weeks' experience with a short underground circuit is no measure of its capacity to fulfill the requirements necessary for central station arc-lighting, as it requires time to develop the faults in such conductors.

Aside from the question of overwhelming cost, there is no opportunity in cities to lay down subways without such serious interference with gas, water and steam-pipes, and sewers that it would make their construction unfeasible. An underground circuit must be either a buried conductor or wires run through a conduit of small dimensions.

The insulation of buried conductors from those of Prof. Morse in 1843 to the present day, has not been sufficiently permanent to reach satisfactory results, although such cables have given excellent results on submarine work, where they are free from many of the severe conditions imposed on them by underground service in cities.

It is clearly essential that the insulation upon wires in conduits must be supplemented by the material of the conduit, also serving as an insulator.

In the oft-quoted subways of Paris, the wires are not in contact with the walls, but are attached to insulators fastened to beams, placed transversely across the subway, or against the walls, and are therefore suspended lines, surrounded by an insulation of air.

The use of underground systems would add to the obstructions of opened streets, increasing the measure of annoyance and danger arising from excavations in the highway, a difficulty which will increase in time, whether lines were successful or not, for if successful, the increased patronage would require additional wires; and, if unsuccessful, the constant repairs and alterations, in the hope of obtaining satisfactory methods, would require certainly more occupation and interference with the highway.

Admitting each statement alleged against overhead wires, there would still remain the fact that the experiment of underground wires involves dangers and difficulties that should not be rashly entered upon, lest, like the discontented frogs in the fable, king stork takes the throne of king log.

In conclusion, it may be said:

1. That the present application of electricity forms a relatively safe method of lighting.

2. Underground wires conducting lighting currents contain elements of serious danger in proportion to their defects of insulation.

3. The compulsory burial of all electric wires would be oppressive to the electric interests.

Our methods of life are so closely interwoven with the the uses of electricity that we are dependent upon its applications, especially to transmission of speech, telegraphy and illumination, and any interference with the legitimate exercise of those interests will not be measured by the impaired value of plant or load of excessive expenditures, but will be a detriment to each member of the community now benefited by its use.

After some discussion of the subject of insurance, a resolution was offered by Mr. Cleveland, of Hartford, Conn., declaring that the association endorsed the plan of a mutual electric light insurance company, as suggested by Mr. Gilbert, of New Haven.

On motion of Mr. Weeks, the membership of the executive committee was changed from six to seven.

Officers were elected for the ensuing year as follows:

President—J. F. Morrison, of the Brush Company, Baltimore.

First Vice-President—H. M. Cleveland, Waterhouse Electric Manufacturing Company, Hartford, Conn.; Second Vice President—E. R. Weeks, Thomson-Houston system, Kansas City, Mo.

Treasurer—Chas. Cooper, Thomson-Houston system, Brooklyn, N. Y.

Executive Committee—A. J. De Camp, Brush system, Philadelphia; Frank Ridlon, Brush-Swan Co., Boston; Eugene T. Lynch, Jr., United States system, New York; Geo. S. Bowen, Elgin, Ill.; Otto Moses, of New York; Joseph A. Corby, St. Joseph, Mo.; John R. Fletcher, Dayton, Ohio. The president is to appoint the secretary.

On motion of Mr. Ridlon, the establishment of a bureau of information was ordered, to be under the direction of the president. The practice of old companies in coming into cities and towns where new companies had already established electric light systems, and bringing about a ruinous competition, was criticised and denounced. The last act of the association, on motion of Dr. Moses, was to elect to honorary membership, Professor Marcel Deprez, Dr. Cornelius Herz, editor and proprietor of *La Lumière électrique*, and Baron Alphonse de Rothschild, all of Paris, the last-named furnishing the capital to the first two to conduct their costly electrical experiments.

The convention adjourned to meet in Detroit, Mich., next August, the day to be selected by the executive committee.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING FEB. 9, 1886.

335,560 Double-track cable, or electric road; Chester Bullock, Kansas City, Mo., assignor of one-half to Robert Gilham, same place.

335,588 Telephone system; Charles A. Jackson, Lawrence, Mass., assignor to David F. Robinson, same place.

335,604 Electrical call system for hotels; James C. McLaughlin, Cincinnati, Ohio.

335,605 Automatic circuit-closer for telegraph keys; Andrew C. McNeal, Gergersville, Ky., assignor of one-half to Wm. H. Tyree, same place.

335,659 Regulator for dynamo-electric machines; C. J. VanDepoele, Chicago, Ill.

335,679 Ring for cable coverings; Chester Bullock, Kansas City, Mo.

335,681 Multiple harmonic printing telegraph; Geo. A. Cardwell, Brooklyn, N. Y., assignor of two-thirds to Frederick K. Fitch, New York, N. Y., and Joseph T. Murray, Newark, N. J.; said Murray assignor of one-half of his right to William Phillip Arnold, Elizabeth, N. J.

335,682 Transmitter for harmonic printing telegraphs; Geo. A. Cardwell, Brooklyn, N. Y., and Frederick K. Fitch, New York, N. Y., assignors of one-third to Joseph T. Murray, Newark, N. J.

335,687 Electric meter; John I. Drake, Providence, R. I.

335,693 Electric call generator; Ezra T. Gilliland, Boston, Mass.

335,708 Automatic telephone exchange system; Thos. D. Lockwood, Malden, Mass.

335,781 Electro-dynamic motor; Frank J. Sprague, New York, N. Y.

335,786 Electric arc-lamp; Nikola Tesla, Smiljan-Lika, Austria-Hungary, assignor to the Tesla Electric Light and Mfg. Co., Rahway, N. J.

335,787 Electric arc-lamp; Nikola Tesla, Smiljan-Lika, Austria-Hungary, assignor to the Tesla Electric Light and Mfg. Co., Rahway, N. J.

335,806 Telephone transmitter; Warren P. Freeman, New York, N. Y., assignor to Benjamin S. Clark, same place.

335,852 Electrical signaling apparatus; Henry Thau, New York, N. Y.

335,860 Electric clock system; Chas. D. Warner, Ansonia, Conn.

335,863 Electric motor; Joseph Weis, Jersey City, N. J.

335,934 Signal system for telephone exchanges; Warren S. Johnson, Whitewater, and Charles L. Fortier, Milwaukee, Wis.

335,970 Electrical igniter for gas engines; Chas. E. Skinner, Yonkers, N. Y.

335,996 Machine for cutting cloth; Francis L. Eschback, New York, N. Y.

335,998 Electric motor; Frank E. Fisher, Detroit, Mich.

335,999 Magneto-electric bell; Frank E. Fisher, Detroit, Mich.

336,000 Magneto-electric machine; Frank E. Fisher, Detroit, Mich.

336,001 Annunciator; Frank E. Fisher, Detroit, Mich.

336,002 Telephone call-bell system; Frank E. Fisher, Detroit, Mich.

336,003 Push-button; Frank E. Fisher, Detroit, Mich.

336,004 Electric-clock system; Frank E. Fisher, Detroit, Mich.

336,030 Apparatus for treating ores; Jacob C. Wiswell, Medford, Mass., assignor to the Wiswell Electric Mining Machinery Company, Portland, Maine.

336,040 Telegraph and telephone protector; Charles C. Drake, Trenton, N. J.

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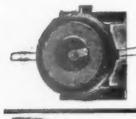

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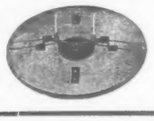

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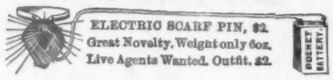

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HAVING AN OFFICE AT BOSTON, MASS., RESPECTFULLY NOTIFIES ALL PARTIES MANUFACTURING OR DEALING IN ELECTRIC LIGHT APPARATUS, THAT IT OWNS, AMONG OTHERS, THE FOLLOWING EXISTING LETTERS PATENT OF THE UNITED STATES, VIZ:

Thomson & Houston, March 1, 1881, Current Regulator for Dynamo-Electric Machines, No. 238,315.

Elihu Thomson, Oct. 10, 1882, Regulator for Dynamo-Electric Machines, No. 265,937.

Elihu Thomson, Dec. 26, 1882, Regulator for Dynamo-Electric Machines, No. 269,606.

Elihu Thomson, Feb. 6, 1883, Electric Current Regulator, No. 271,948.

The above patents fully cover the principle and methods of automatically regulating the electric current without the use of variable resistances, and without waste and loss of power. By these inventions all irregularities in speed of engines are compensated for and any number of lights can be freely turned on or off at will without any attention to either dynamo or regulator. These advantages are possessed by no other system of electric lighting, and upon such advantages depend almost entirely the profits of local electric lighting companies.

We hereby notify all manufacturers, purchasers or users of electric lighting apparatus that any violation or infringement of the above-named patents will be prosecuted to the fullest extent of the law.

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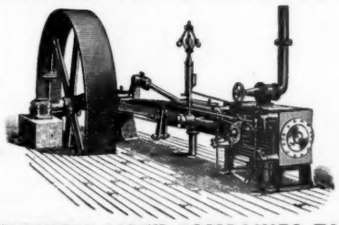

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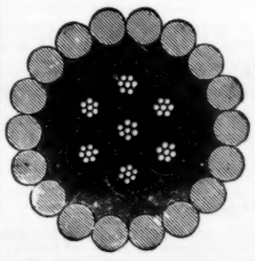

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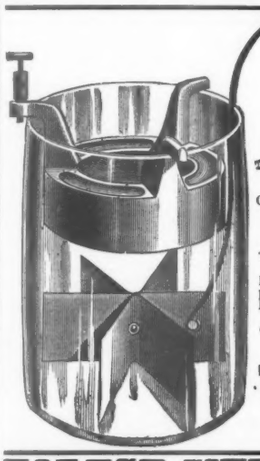

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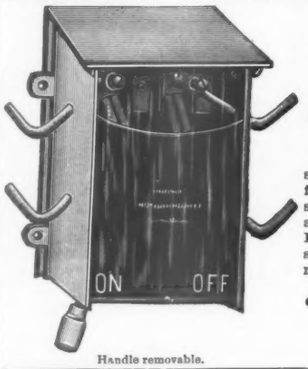

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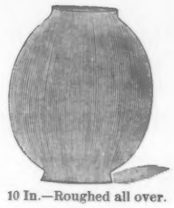

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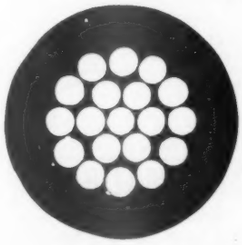

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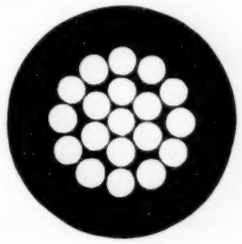

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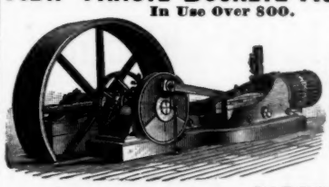

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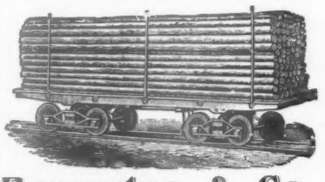

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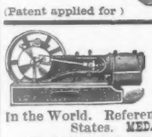

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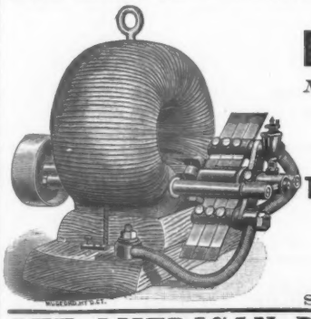

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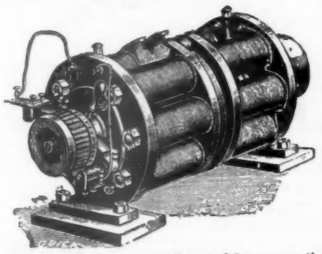

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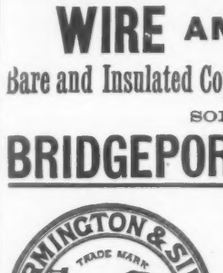

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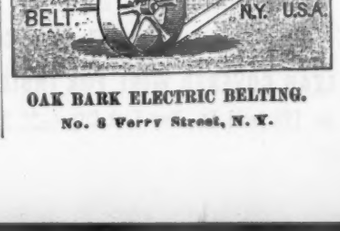

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